EX LIBRIS
DR. JAMES W. WARD

A HANDBOOK

OF

INTESTINAL SURGERY

A HANDBOOK

OF

INTESTINAL SURGERY

BY

LEONARD A. BIDWELL, F.R.C.S.

SURGEON WEST LONDON HOSPITAL; LECTURER ON INTESTINAL SURGERY, AND
DEAN OF THE POST-GRADUATE COLLEGE; CONSULTING SURGEON TO THE
BLACKHEATH AND CHARLTON AND DISS HOSPITALS, ETC.

SECOND EDITION

NEW YORK

WILLIAM WOOD & COMPANY

MDCCCCXI

PREFACE TO THE SECOND EDITION

THE progress of intestinal surgery is so rapid that many parts of this book have had to be entirely re-written to bring it up to date ; much fresh matter has been introduced, and several fresh illustrations added.   In response to many inquiries about the little intestine-holder, which is used when practising sutures on bullock's intestine, I have had a portable one made by Messrs. Allen and Hanbury, as illustrated opposite.

I have found that most of my class have very indistinct ideas about the distances represented by $\frac{1}{8}$ inch or $\frac{1}{4}$ inch, so I have had a small gauge cut in the stand of the holder to show these fractions.

The importance of practising the various sutures on bullock intestine with the aid of the intestine-holder cannot be over-estimated.

<div align="right">L. A. BIDWELL.</div>

15, UPPER WIMPOLE STREET, W.
September, 1910.

PREFACE TO THE FIRST EDITION

THIS little volume aims at giving such a precise description of the commoner intestinal sutures that an inexperienced surgeon may readily practise the various methods on dead intestine before performing an anastomosis on the living subject.

The book owes its origin to the establishment of a class in intestinal surgery at the West London Post-Graduate College, and it contains a full description of the work done in this class. The material which I use for these classes is the small intestine of bullocks, which I am fortunate enough to obtain the day the animal is killed. Bullock's intestine is of practically the same thickness as that of man, and if used quite fresh resembles to the touch and in resistance the intestine of a living man much more closely than does human intestine removed in the post-mortem room. It, moreover, has the advantage of being odourless and of not soiling the hands. In order to enable an anastomosis to be performed single-handed, each student is provided with a little intestine-holder, which is figured on p. 56, and takes the place of a first-rate assistant. In such a book, with the aid of which, it is hoped, the student may dispense with class teaching, numerous and clear illustrations are of the first importance, and I have been very fortunate in obtaining the assistance of Dr. Leonard Mark and of my colleague,

vii

Mr. A. Baldwin, to whose artistic illustrations much of the usefulness of the book will be due.   I have to acknowledge the courtesy of my friend Mr. Watson Cheyne, and of Messrs. W. B. Saunders and Co., who have kindly allowed me to copy the diagrams which bear their names. I have also to thank Dr. Maunsell, Mr. Jessett, and Messrs. Down Bros. for the loan of a number of blocks.

The last two chapters on the preparation before and the treatment after operations are lectures delivered at the Post-Graduate College, and were originally published in the *Clinical Journal*.

<div align="right">L. A. BIDWELL.</div>

UPPER WIMPOLE STREET, W.
<div align="center">*May*, 1905.</div>

CONTENTS

CHAPTER I

CHAPTER II

CHAPTER III

CHAPTER IV

CHAPTER V

CHAPTER VI

CHAPTER VII

CHAPTER VIII

CHAPTER IX

LIST OF ILLUSTRATIONS

List of Illustrations

INTESTINAL SURGERY

CHAPTER I

SECTION I

GENERAL CONSIDERATIONS

I. **Anatomical Conditions.**—The small intestine has four important coats, as shown in Fig. 2. They vary in thickness and in toughness in different parts of the bowel.

1. The peritoneal coat does not completely surround the gut in any part of the intestine; there is always a portion of the circumference of the bowel between the attachments of the mesentery, which is not covered with peritoneum. The extent of this uncovered area varies in different parts. It is smallest in the jejunum, where only about one-tenth of the circumference is uncovered. In the duodenum, ascending and descending colons, the portion which is not covered with peritoneum is nearly one-half of the circumference, and in the transverse colon and sigmoid the uncovered area is about one-fifth of the whole.

2. The muscular layer is the thickest coat of the bowel, and consists of longitudinal and circular fibres. Although of considerable thickness, it is not, however, of great strength, and sutures which take a hold of this coat only

I

will readily cut out. The thickness of the coat varies
with the contraction or dilatation of the gut, being many
times less in paralytic distension than in normal tonic
contraction.

3. The submucous coat is not of great thickness, but
it is composed of very tough fibrous tissue, and only a
few fibres of this coat have a greater resisting power than
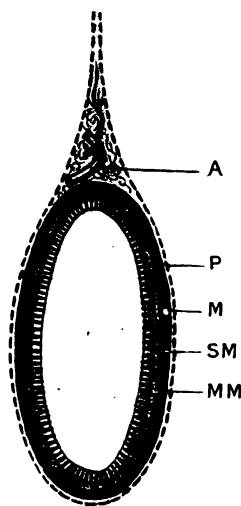
FIG. 2.—THE COATS OF THE ILEUM.   (L. MARK.)
P, peritoneal coat; M, muscular coat; SM, submucous coat;
MM, mucous membrane; A, artery of mesentery.

the whole of the serous and muscular coats. It is essential,
in order to secure firm union, that a portion of this coat
be included in each suture.

4. The mucous membrane varies much in thickness,
being thickest in the jejunum, and thinnest in the lower
part of the ileum and in the large intestine. The coat
is very friable, and sutures passed through this coat alone
will easily cut out.

The fact that valvulæ conniventes are present in large

numbers in the jejunum, and can be easily felt through the bowel, while they are absent in the lower part of the ileum, gives us an easy way of distinguishing a coil of jejunum from one of the ileum.

To sum up, the mucous coat is the most friable, the submucous coat is the toughest, the muscular coat is the thickest, but not the strongest, and the peritoneal coat is the most delicate and is incomplete.

The peritoneal coat, however, is of the very greatest importance, since the earliest and firmest adhesions between portions of intestine are formed between adjacent peritoneal surfaces. It is, therefore, essential that portions of intestines which are covered with peritoneum should be selected for an anastomosis.

In the small intestine the two sides of the mesentery are sufficiently close together for the mesenteric portions of the bowel to be brought in contact without any break in the peritoneal investment; therefore end-to-end anastomosis presents no great difficulty. In the ascending and descending colon, however, the absence of a peritoneal covering over one-half the circumference makes an end-to-end anastomosis a hazardous procedure.

Generally speaking, the part of the intestinal wall which unites most readily is the convex border, or that portion exactly opposite to the mesenteric attachment; this is the point selected for incision of the gut in the case of extraction of a foreign body such as a gall-stone, or for an enterostomy for the temporary relief of obstruction. This also is the point selected for the line of union in performing a lateral anastomosis, and so it follows that a lateral anastomosis is a very safe method of uniting intestines.

II. Another point of importance is that the anastomosis should be made between equally movable portions

of gut, and it is undesirable that a movable piece of gut should be united to a fixed one, since the peristaltic contractions in a movable piece of gut united to a fixed piece will pull upon the stitches. Thus the ileum should not be connected to the ascending or descending colon, but when it is necessary to unite it to a portion of the large intestine the union should be made with the transverse colon or the sigmoid. In the same way the only parts of the large intestine which should be united to each other are the transverse colon or the sigmoid. Again, the fixed duodenum should not be united to the movable stomach, but the movable jejunum should be selected when doing a gastro-enterostomy.

. III. When the knots of sutures are left on the peritoneal surface of the gut, it is essential that the suture should not penetrate through all the coats of the gut, since the suture would then become infected by the intestinal contents. It is quite a question whether the mere fact of the silk becoming infected by intestinal contents will lead to peritonitis; the real danger lies in the fact that when once a suture has become infected it will have to separate, and it will do this in the direction of least resistance. This will be into the lumen of the bowel, because in normal conditions there is no peritoneal cavity, the intestines being packed closely together, and any extravasation is prevented by intra-abdominal pressure. When the knot is on the serous surface, and the suture has become infected, the knot has to traverse the whole thickness of the bowel coats, so a considerable amount of ulceration is necessary to allow it to pass into the lumen, and the tract left is of such considerable size that some extravasation may occur, which would lead to the development of serious adhesions. When, however, the knot is inside the bowel, a little irritation is set up

in the serous coat just round the suture, which effectually shuts off the peritoneal cavity, and then sufficient inflammation and ulceration are excited to cast off the suture within the cavity of the bowel, a very small tract being left after it has been discharged. The peritoneal end of the tract is sealed by peritoneal adhesions, and so no extravasation or serious adhesions will occur.

When, therefore, sutures pass through all the coats, the knot should be placed on the mucous surface of the bowel, and even if no supporting row of Lembert sutures be inserted, these will not lead to infection, extravasation, or adhesions.

IV. It is most essential to tie each stitch as tightly as possible—first as a test that the suture has been properly passed, for the stitch will cut out if the submucous coat has not been included, and it is preferable that the stitch should cut out at the time of the operation than that this should happen some time after ; secondly, because a stitch which is tied sufficiently tightly when the gut is collapsed will become loose when the gut is distended, the reason being that when the bowel is collapsed the muscular coat is thick, while when the bowel is dilated all its coats are thinned. It must be remembered that every injury to the intestine will produce some temporary paralysis, which is accompanied by dilatation of the gut.

V. The anastomoses should, when possible, be done outside the abdominal cavity, so as to lessen the risk of peritoneal infection ; this is not difficult, when movable portions of the gut are to be united. It is also important to prevent the cut tissues of the abdominal wall from being infected by intestinal contents, as this would cause suppuration of the abdominal wound. This is prevented by packing gauze swabs inside the edges of the abdo-

minal incision. The temporary soiling of the intestines
or stomach is of no consequence, provided that the parts
be well washed with saline solution before returning them
inside the abdomen.

VI. A surgeon should not be dependent upon any
special apparatus for the performance of an anastomosis,
since the necessity for the performance will often arise
in the course of some other operation when the special
apparatus is not at hand. It is therefore desirable that
he should first be perfect in some simple method of suture
alone, and after this he can use any apparatus if he
desires it.

VII. Other things being equal, the patient's chances
of recovery are greatly enhanced by rapid operating,
and this can only be obtained by practice.

VIII. It is almost unnecessary to impress upon the
surgeon the necessity of counting all instruments and
sponges employed before and after an operation.

SECTION II

MATERIALS REQUIRED FOR AN INTESTINAL ANASTOMOSIS

The ordinary instruments required are a scalpel,
eighteen or twenty-four small Spencer Wells forceps,
dissecting forceps (two pairs), two large abdominal
retractors, two small retractors, a pair of blunt hooks
(button-hooks do very well in an emergency), a needle-
holder to take curved needles (as made by Krohne and
Seesman), and ordinary surgical needles for closing the
skin incision.

The special instruments required are (1) intestinal
needles, and (2) clamps. It is most important to
have proper needles, since, if ordinary surgical needles

with sharp sides be used, there is a great risk of the
delicate coats of the intestines being cut through if
the needle be held at all slantingly. It is therefore
essential to have needles with round bodies. Both
straight and curved needles should be at hand ; the
straight needles are ordinary sewing-needles, which can
be obtained from any haberdasher, and the most con-
venient size is No. 7. It is convenient to have rather
a longer needle than the sewing-needle, and such a one
is called a straw needle. In order to use a small-size
needle, I recommend that the open-ended or calyx-eyed
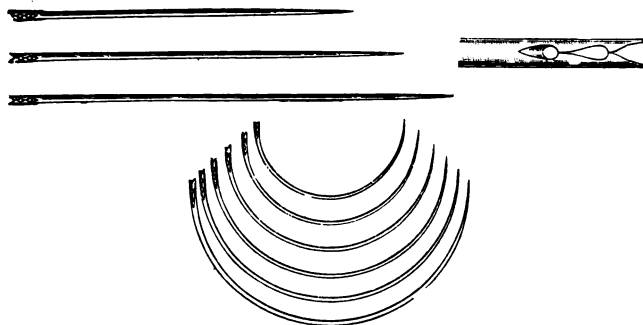
FIG. 3.—STRAIGHT AND CURVED INTESTINAL NEEDLES, WITH
' CALYX ' EYE (ENLARGED SKETCH OF CALYX EYE). (DOWN BROS.)

needle should be obtained ; they save an infinite amount
of trouble in threading—in fact, until I employed them,
I used to find it impossible to thread No. 7 needles with
wet silk, and I had to sterilize the silk and needles together
after threading—an undesirable proceeding, since the
loop of silk within the needle is liable to become rotten
by development of a little rust in the eye of the needle
during boiling. Again, if a needle comes unthreaded
in the middle of a continuous suture, it is easily re-
threaded in the case of a calyx-eyed needle. These
needles have a spring eye, as shown in Fig. 3. They

are threaded by simply passing a piece of silk over the end.

Straight needles are most useful for picking up the submucous coat, since, if they are driven directly inwards towards the lumen of the gut with the pulp of the finger, it is easy to recognize the resistance of the submucous coat.

Curved needles, which must also have round bodies, are useful for continuous sutures, especially when an anastomosis is performed within the abdominal cavity, where straight needles could not be used so easily. I do not advise those with calyx eyes, but I select needles with good oval eyes. I should like to condemn those made with flat, expanded ends. A very useful needle with a conical-shaped eye has been introduced by Paterson; this has the advantage of not becoming unthreaded. The ordinary full curve is the best shape for the needle, and the semicircular one, which is often supplied, is not so suitable, as it is practically impossible to feel with it the resistance of the submucous coat. I should just like to utter a warning against the use of Hagedorn's needle. The cutting edge of the needle and the large round eye make it very unsuitable for intestinal work.

Clamps.

I do not propose to describe all the forms of clamps which have been recommended for intestinal work ; I shall only refer to those which I use myself. One of the best is Doyen's (Fig. 4). You will notice that the blades are made with fine grooves, and are bowed so that their tips meet before the centre. In this way it is easy to regulate the amount of pressure on the gut when it is applied, the chief use of a clamp being to prevent the passage of any intestinal contents, and not to prevent

bleeding, and so it need only be lightly applied, and it is unnecessary and undesirable to apply it so tightly as to risk strangulating the gut. If the clamps are applied too tightly, they will cut through the mucous membrane,
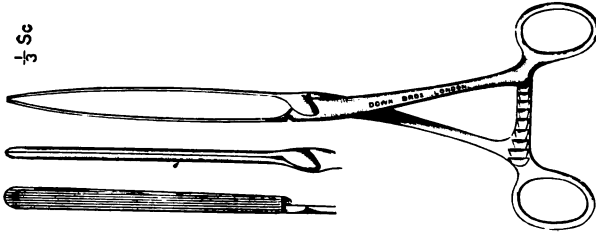
FIG. 4.—DOYEN'S INTESTINAL CLAMP. (DOWN BROS.)

and this would lead to subsequent cicatricial contraction of the lumen of the gut at the point of application. They should not have any rubber-tubing put on their blades before use, since this counterbalances the advantages of the bow shape of the blades. Two of these clamps are a useful addition to the equipment of a surgeon.

The other clamp which I employ and recommend to you is the one introduced by Mr. Arbuthnot Lane, and
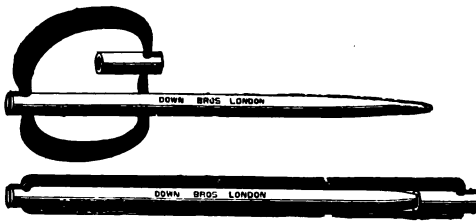
FIG. 5.—LANE'S INTESTINAL CLAMP. (DOWN BROS.)

bears his name. It consists (Fig. 5) of a steel rod, having a blunt point at one end and a notch at its other end, to which an elastic ring is attached ; a small cap with a notch fits on the blunt point, and when the cap is in

position the elastic ring is stretched over the whole. It is applied by passing the blunt point through the mesentery close to the gut, and then applying the small cap with the elastic band attached, so that the gut is compressed between the elastic band and the rod. It is very simple and inexpensive, and two of them should
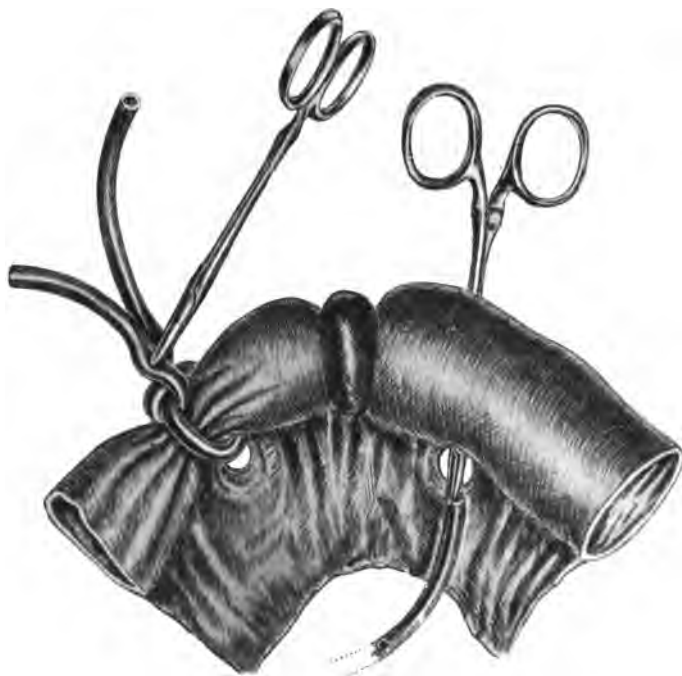
FIG. 6.—METHOD OF CLAMPING INTESTINE BY ELASTIC LIGATURES.
(L. MARK.)

form part of an equipment. The application of this clamp is seen in Fig. 56.

It is, however, most important to be able to clamp the gut without any special apparatus, and the following two methods are very simple and efficacious :

1. A fine pair of Spencer Wells forceps is passed

through the mesentery close to the gut, and about 6 inches of a small-size rubber tubing (sterilized) is drawn through the hole in the mesentery, and the two ends of the tubing tied lightly together over the gut, with just sufficient force to obliterate the canal ; the knot, which is a single one, is prevented from slipping by applying a pair of Spencer Wells forceps as shown in Fig. 6.

Care must be taken that the tips of the forceps do not project beyond the rubber drainage tubing, but the tubing must project beyond them so as to guard them. If the
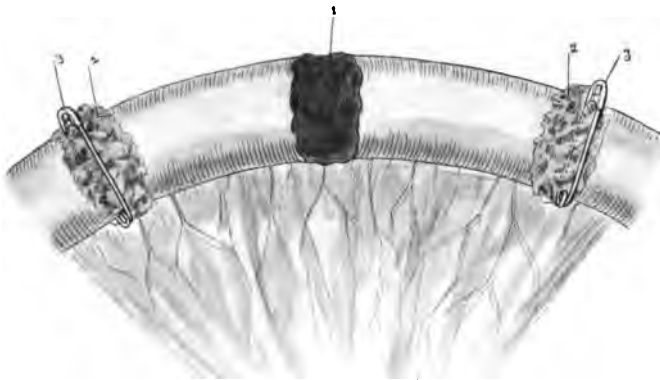
FIG. 7.—MAUNSELL'S SPONGE AND SAFETY-PIN CLAMP.
1, Stricture of intestine ; 2, sponge ; 3, safety-pin passed through mesentery.

points projected beyond the drainage tubing, they would be liable to injure the distended portion of intestine beyond the clamps. The clamp is easily removed by taking off the forceps. I have used this method in a number of cases, and have found it absolutely satisfactory. The constricting tubing cannot slip, as it is passed through the mesentery.

2. Maunsell's method, in which we require a piece of sponge and a safety-pin, both of which are easily steri-

lized by boiling. The safety-pin is passed first through the piece of sponge, then through the mesentery close to the bowel, and then through the sponge again, and fastened ; in this way the bowel is compressed between the safety-pin and the sponge. This is shown in Fig. 7. The piece of sponge should be the same length as the safety-pin. It is a very convenient method, and is very efficacious. I do not like it so much as the method by elastic ligatures.

One word as to the application of clamps. They should not be applied until the bowel is about to be opened. The first row of sutures should be inserted before they are put on, and in Halsted's method the whole of the sutures are inserted before it is necessary to use a clamp. Secondly, they should be applied at some distance, at least 2 inches away from the part to be sutured. There are two reasons for this—(1) that the vessels close to the anastomosis should not be damaged by the clamp, for however carefully a clamp has been applied, it must interfere with the nutrition of the gut in its immediate neighbourhood ; and (2) that the walls of the gut should not be dragged out of position by the clamp. Thirdly, they should be taken off as soon as possible, and in cases where the anastomosis is effected by a double row of sutures the clamp may usually be removed with advantage when the first row has been completed. Lastly, there is no clamp so good as an assistant's fingers ; but if the operation is prolonged, this method is apt to cause fatigue. In gastro-enterostomy by Halsted's method I did not use a clamp, since the sutures are all passed before the bowel is opened, and as the anastomosis is done outside the abdominal cavity, any slight escape of stomach contents can be washed away with saline solution, and cannot find its way into the peritoneal

cavity; so, provided the tissues of the abdominal wall are protected by gauze swabs, which will prevent their irritation by the intestinal contents, no harm will be done. The necessity for the use of clamps is more important in the lower part of the small intestine and in the large intestine, since the intestinal contents in this region contain the *Bacillus coli communis* in large quantities, and are very irritating. Although temporary contact of these contents with the peritoneum would probably lead to no evil effect, provided that they were washed away, infection of the abdominal incision would be quite certain if any of such intestinal contents had come in contact with the tissues of the abdominal wall.

SECTION III

THE VARIETIES OF SUTURE

I. **Interrupted.** — 1. The best-known suture is the Lembert suture, which aims at picking up the peritoneal and fibrous coats alone (*vide* Fig. 8). The essential part of the stitch is that the needle is inserted about $\frac{1}{8}$ inch from the cut edge, and brought out at $\frac{1}{16}$ inch from the edge, so as to produce some inversion of the edge of the gut and insure the apposition of the peritoneal surfaces. It is not, however, a very strong stitch, and is very liable to cut out; this can easily be verified by pulling on it.

Lembert's stitch, as recommended by its originator, is now practically never used. As was pointed out before, it is essential that the submucous coat be included in every suture, so that the stitch, which is now called a Lembert, is made to include some of the fibres of the submucous coat, and is then the best that can be used. We call this stitch a modified Lembert. The question of picking up the submucous coat is more fully referred
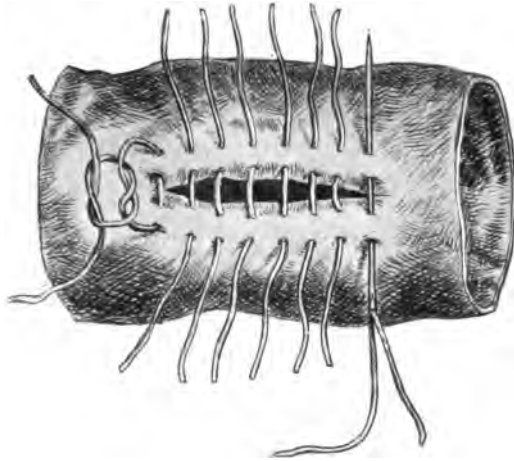
FIG. 8.—LEMBERT'S SUTURE.   (L. MARK.)

FIG. 9.—CZERNY-LEMBERT SUTURE.   (L. MARK.)
The Czerny stitch is the lower one, passing through the mucous membrane alone.   Above this is an ordinary Lembert stitch.

to in Halsted's method.   Each Lembert stitch is inserted $\frac{1}{8}$ inch apart.   Speaking generally, the distance between the stitches corresponds to the distance at which they

are inserted from the cut edge. As just stated, these stitches are to be inserted $\frac{1}{8}$ inch from the cut edge, and therefore they are to be $\frac{1}{8}$ inch apart. If they had been inserted $\frac{1}{4}$ inch from the cut edge, they might be $\frac{1}{4}$ inch apart, but if they were $\frac{1}{16}$ inch from the cut edge, they would have to be $\frac{1}{16}$ inch apart.

2. The Czerny stitch is one which is passed through the mucous membrane alone, and the knot is tied on the
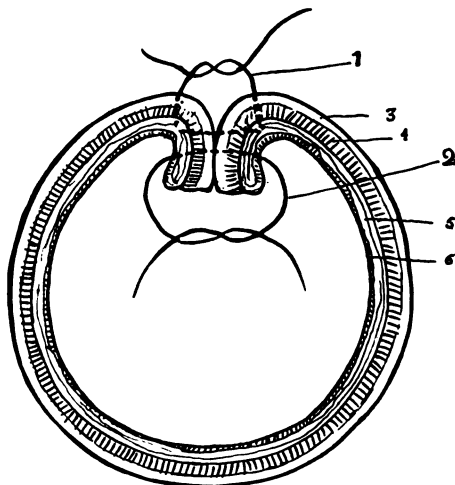
FIG. 10.—WÖLFER'S SUTURE.

1, Lembert's suture passed through serous, muscular, and submucous coats; 2, modified Czerny suture passed through all the coats, and tied inside the bowel; 3, serous coat; 4, muscular coat; 5, submucous coat; 6, mucous membrane.

free side of this coat. This stitch is shown in Fig. 9; it is only used in combination with modified Lembert's stitches.

3. In Wölfer's method, the first row of stitches passes through all the coats of the bowel, and the knots are tied on the mucous surface; each stitch is passed from the mucous to the serous surface of one edge, and from the serous to the mucous surface of the other edge. Before

tying the knots, the stitch should be pulled tight with a little jerk, which causes inversion of the serous surfaces. The method is completed by a row of modified Lembert's sutures. This is an excellent method, and gives a strong support.

4. Joubert's stitch, as shown in Fig. 11, aims at producing an invagination of one portion of the intestine into the other, but it cannot be recommended, since it is passed through all the coats of the bowel and has its knot
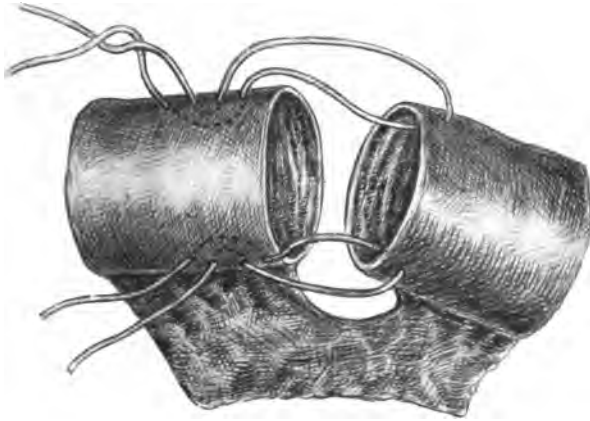
FIG. 11.—JOUBERT'S METHOD.   (L. MARK.)

on the peritoneal surface. Infection is therefore probable, unless a supporting row of Lembert's stitches be inserted in addition.

5. **Halsted's Method.**—In this method each stitch is made to pick up some of the fibres of the submucous coat, for, as already pointed out, the fibrous tissue of this coat is stronger than that of any other. If a needle is passed with steady pressure vertically towards the lumen of the gut, it will be found that a considerable steady pressure is needed before the gut is perforated ; of course, a jerk will perforate it at once. The resistance felt on steady

pressure is the submucous coat. If, then, the needle is pressed steadily toward the lumen, and when the resistance is felt it be lateralized, and pushed on so as to emerge from the serous coat again, the point will pick up some fibres of the submucous coat. Halsted employs a double stitch, called a mattress suture, so as to bring a larger amount of serous surface in apposition. The needle is made to enter at $\frac{1}{8}$ inch from, and to come out at $\frac{1}{16}$ inch from one cut edge, then to enter at $\frac{1}{16}$ inch
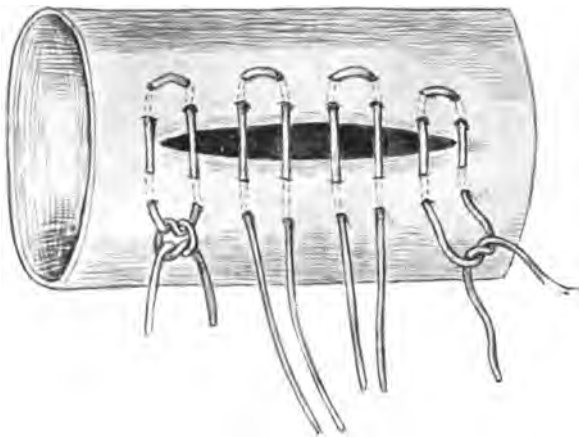
FIG. 12.—HALSTED'S MATTRESS SUTURE BEING INSERTED. (L. MARK.)

from and to emerge at $\frac{1}{8}$ inch from the opposite edge; it is then reinserted $\frac{1}{8}$ inch away from the point of exit, passed in the opposite direction at the same distances from both edges. Each stitch should be $\frac{1}{8}$ inch apart, and the row should be parallel and equidistant (see Fig. 12). In order to insure this, it is best to pass the whole row of sutures, and clamp their ends before tying any. This stitch is an ideal one, since it is absolutely strong, and yet it does not perforate the mucous membrane, and no extravasation can take place. The only objection to its use is that it causes a certain amount of contraction

2

of the line of suture. Where this is of consequence, it is therefore wise to pass modified Lembert sutures instead of mattress sutures.

II. **Continuous.**—Continuous sutures may be considered under the same heading as interrupted—namely, those with their knots on the peritoneal surface, and those which penetrate the whole thickness of the gut. In passing continuous peritoneal sutures, it is essential— (1) to pull each stitch tight after passing it; (2) to keep it taut while passing the next stitch; (3) to prevent undue puckering when putting in the stitch; and (4) to oversew
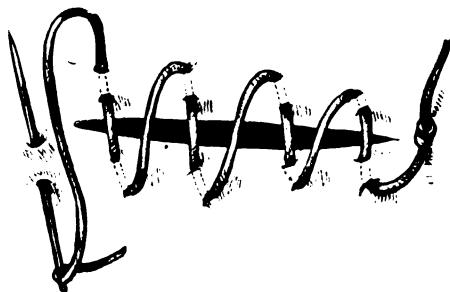
FIG. 13.—CONTINUOUS LEMBERT OR DUPUYTREN. (L. MARK.)

the suture every third or fourth stitch. This is shown in Fig. 18.

1. The simplest form of serous suture is the continuous Lembert or Dupuytren's suture, which is used in most cases where two rows of sutures are inserted. It is inserted in the same way as the modified Lembert, the needle being inserted $\frac{1}{8}$ inch from the cut edge, and care should be taken that the needle is made to pick up some fibres of the submucous coat in each stitch, and to enter points on each edge opposite to one another.

The best way to prevent puckering and subsequent contraction of the line of suture is to use guides, which are held apart by the assistant while the suture is being

inserted. These guides are passed as ordinary modified Lembert sutures, which are tied ; both ends of one stitch and one end of the other are clamped, and the clamps are held firmly apart by the assistant ; the long end of one stitch, to which the needle is attached, is then used for the continuous suture ; each stitch of a continuous suture is inserted ⅛ inch apart, and the silk is held taut by the surgeon while passing the next stitch. The method of insertion of guides is seen in Fig. 14.

The stitch is finished off by tying it to one of the ends of the second guide, which has already been inserted, or
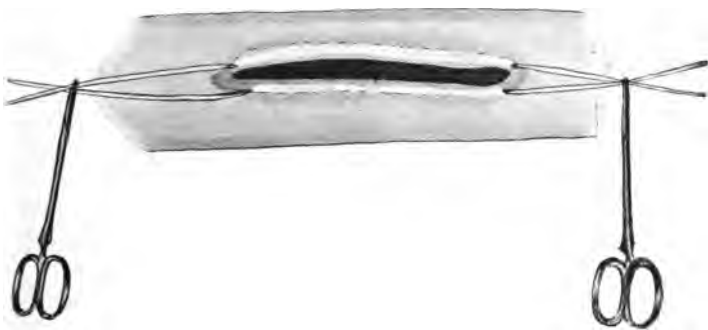
FIG. 14.—THE METHOD OF INSERTION OF GUIDES PRIOR TO DOING THE CONTINUOUS LEMBERT.

it may be finished off by means of the short end of the silk ; to do this the short end is not allowed to pass through the last two stitch-holes, when it can be tied to the double thread attached to the needle. This is shown in Fig. 117.

2. Cushing's suture is explained by Fig. 15. After passing and tying an ordinary modified Lembert's stitch, the suture is continued by inserting the needle parallel to the incision in the gut and about ⅛ inch from its edge. A portion of the serous muscular and submucous coats are then picked up, and the needle is inserted in a similar

direction on the opposite edge of the incision, ⅛ inch
below the former stitch. This is continued to the end of
the wound, and the stitch is finished off by uniting its
free end to one end of a Lembert's suture, which is passed
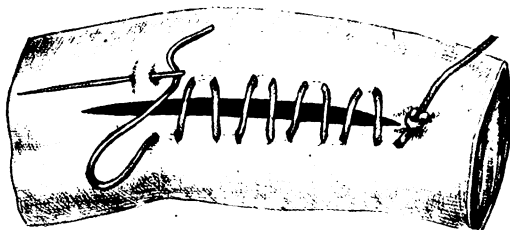
FIG. 15.—CONTINUOUS CUSHING SUTURE.

and tied beyond the end of the wound. This suture
cannot be oversewn to prevent puckering, and cannot be
used with guides. It is practically only used in cases of
anastomosis with bone bobbins.
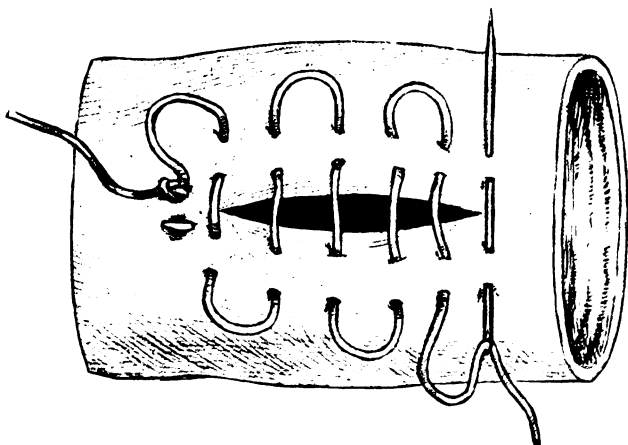
FIG. 16.—CONTINUOUS MATTRESS STITCH. (L. MARK.)

3. I frequently employ a continuous suture passed in
the same way as a Halsted's stitch. After passing and
tying an ordinary Halsted's mattress suture, another is

passed just beyond it with the same silk ; this stitch is
then continued backwards and forwards across the wound
to its end, each thread being ⅛ inch apart ; it is finished
off by uniting the free end to another Halsted's stitch,
which is passed and tied beyond the end of the wound.
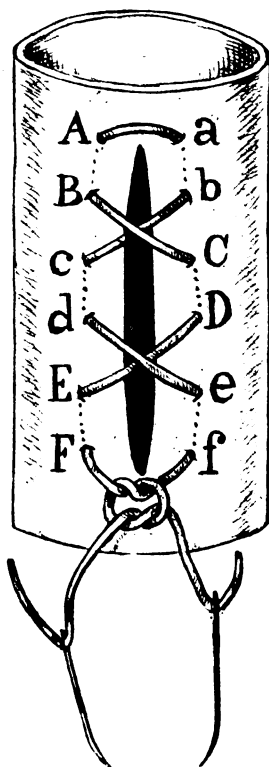
FIG. 17.—GELY'S STITCH. (L. MARK.)

The large letters represent the stitches made with one needle, and the
small letters represent those made with the other needle.

This makes a very firm suture, but produces a good deal
of puckering. It is shown in Fig. 16.

4. Gely's suture is also a secure one, and is recom-
mended for closing an incised wound of the gut. It is

used with two needles, which are inserted one at each side, parallel to and about ⅛ inch from the edge of the wound. The needles are then crossed and inserted below in a similar way. The method resembles lacing up a boot ; this is shown in Fig 17. This suture produces a great deal of puckering of the wound.

Of the continuous sutures, which pass through the whole thickness of the gut, we need only consider three varieties :

  1. Glover's stitch or ordinary top sewing. This stitch
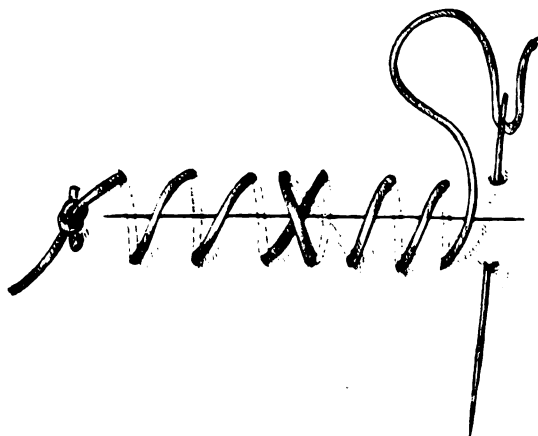
FIG. 18.—CONTINUOUS GLOVER'S STITCH. (L. MARK.)

should also be used with guides, which are inserted at each end of the line, both sutures being passed through all the coats and tied with their knots on the mucous surface. These guides are held apart by the assistant, and a continuous suture is inserted, each stitch being ⅛ inch apart, and the silk being held taut during the insertion of each stitch ; the suture is oversewn as in the continuous Lembert stitch. It is finished off by tying it to one end of the second guide. The stitch is seen in Fig. 18.

  2. The lateral purse-string suture is inserted by passing

the needle in and out through the whole thickness of the bowel, $\frac{1}{4}$ inch from the cut edge, each insertion of the needle being $\frac{1}{4}$ inch apart. This is shown in Fig. 19.

3. The purse-string suture, when applied to the cut end of the bowel, is rather different. It is commenced at the convex border of the gut, the needle being passed from the serous to the mucous coat ; it is always passed in the same direction, oversewing the edge of the bowel, the stitches being inserted $\frac{1}{4}$ inch apart. When the stitch reaches the mesentery, it is best to pass the needle
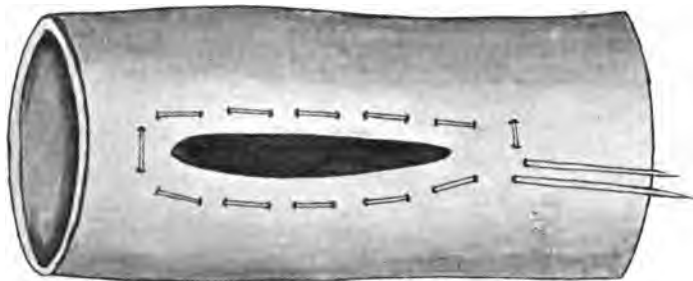
FIG. 19.—LATERAL PURSE-STRING SUTURE.

through both layers of the mesentery in the opposite direction to that in which one is sewing, and then to recommence the stitch on the other side of the mesentery, passing the needle from the serous to the mucous coats as before. This catches up the mesentery in a sort of figure-of-eight stitch. When the stitch reaches the convex border, it must be brought from the mucous to the serous surface, so that the two ends are on the same surface. This stitch is used in occluding the end of the bowel, and in the application of Murphy's button. It is shown in Fig. 79.

CHAPTER II

SECTION I

METHOD OF CLOSING AN INCISED WOUND IN THE BOWEL

THIS should always be done by a double row of sutures when possible, and a series of interrupted stitches is preferable to one continuous suture, since the latter causes more contraction and puckering of the scar. A row of interrupted stitches should be passed from within out-
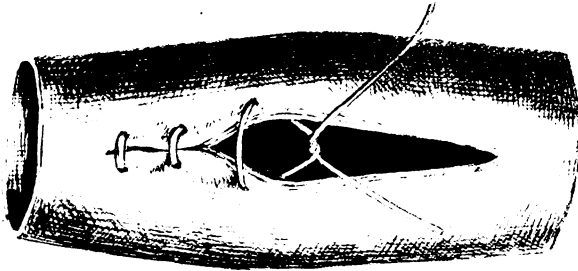
FIG. 20.—METHOD OF CLOSING A WOUND IN THE BOWEL.
(L. MARK.)

These stitches are commenced at the mucous membrane, and when tied the knots will be inside.

wards through all the coats of the bowel, and tied with their knots inside. Each stitch must be passed from the mucous surface to the serous, and made to enter the serous coat on the opposite side, being finished on the mucous surface. Before tying, it should be given a little jerk, which produces inversion of the serous surface, and

it should then be tied very tightly, and its ends cut short.

It is quite easy to get the knots of all the earlier stitches inside the bowel, but the knot of the last stitch may present some difficulty. The best way to insure that the knot of the last stitch is on the mucous surface is to leave the penultimate stitch untied, and to pass and tie the last stitch before tying the penultimate. The last stitch is best passed with the loop of the thread toward the extreme end of the incision, so that the two knots, when tied, face each other. They can be tucked inside
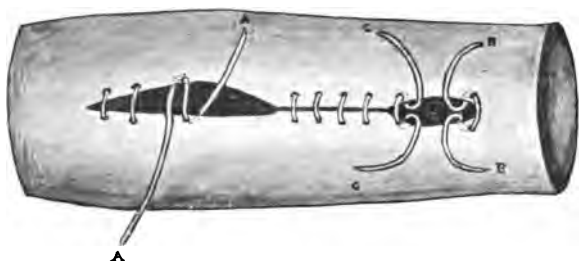
FIG. 21.—METHOD OF CLOSING A WOUND IN THE BOWEL.
A, The wrong way to pass a stitch ; B and C, the last two stitches passed so that the two last knots, when tied, face each other.

the lumen of the bowel with a needle or with a pair of sinus forceps (see Fig. 21, B and C).

A mistake which may be made in passing these sutures is to get the two ends of the thread on different sides of the central loop of the stitch, as shown in Fig. 21, A. This would lead to the knot being on the serous surface when the suture was tied.

The union is completed by a row of Halsted's or modified Lembert's stitches passed in the way directed in the last chapter. One point to be remembered is that the first and last peritoneal stitches must be passed beyond the limits of the incision. Fig. 22 shows this.

Instead of the Lembert's or Halsted's sutures, a continuous mattress or Gely's suture may be employed.

In the case of an incision or wound not exceeding
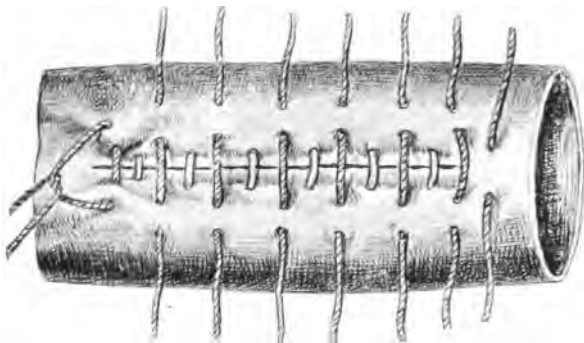
FIG. 22.—CLOSING WOUND IN THE BOWEL.   (L. MARK.)
The first row of sutures have been tied with their knots inside.   The row
of Lembert's have been passed, but have not been tied.
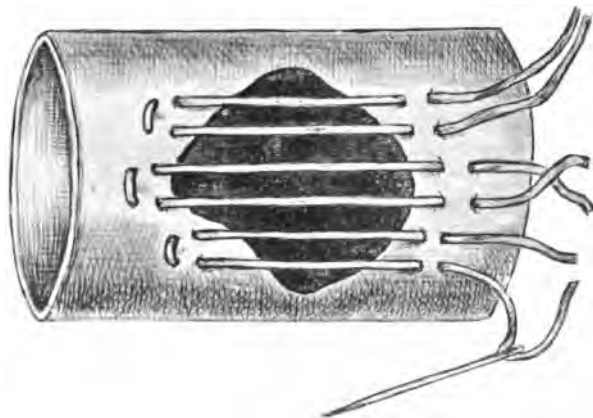
FIG. 23.—METHOD OF CLOSING WOUND WITH LOSS OF SUBSTANCE.
(L. MARK.)
Three Halsted's sutures have been passed.

$\frac{1}{2}$ inch in length, a single row of Halsted's sutures will suffice to seal the opening.

If the wound has involved loss of substance of the

circumference of the bowel, this method might lead to severe contraction. In such a case it is advisable to suture the wound transversely to the axis of the bowel. This is done by passing the first stitch through all the coats, ¼ inch beyond each extremity of the wound ; the stitch, when tied, will be in the centre of the scar. Sutures with their knots on the mucous surface are then passed on each side of the central stitch. The operation is completed by a row of Halsted's sutures, and the result is a
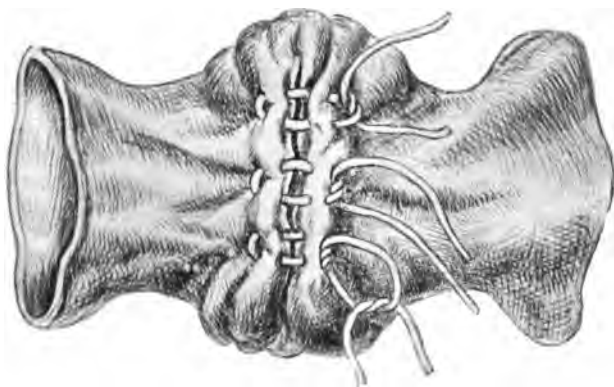
FIG. 24.—THE APPEARANCE WHEN THE SUTURES ARE TIED. (L. MARK.)

transverse scar instead of a vertical one. This is shown in Figs. 23 and 24.

SECTION II

THE CHOICE BETWEEN A LATERAL AND AN END-TO-END ANASTOMOSIS

The following are the advantages of a lateral anastomosis :

1. The union is made at the convex borders of the bowel, where the peritoneal covering is complete, and so is placed in the best position for strong and early adhesions.

2. As the incision in the bowel is made at some distance from the mesentery, the bleeding is slight, and practically no ligatures are required to stop hæmorrhage.

3. It is easy to perform, and if Halsted's method be employed, there is no risk of any escape of intestinal contents.

4. The avoidance of the mesenteric border of the bowel in this method obviates any risk of extravasation between the layers of the mesentery.

5. The opening can be made of considerable length, and, as it does not contract very much, there is no likelihood of stricture resulting.

The disadvantages are :

1. The intestinal contents may not go through the new opening. This difficulty can be obviated by occluding the bowel beyond the anastomosis, so as to divert the whole of the contents through the new opening ; this involves suture of two ends of bowel.

2. The length of time occupied in the performance of this triple operation is greater than in a simple end-to-end anastomosis.

3. The opening is not in the direct axis of the intestine, although it tends to become so after a time.

4. No special apparatus can be profitably used in lateral anastomoses, since either a bobbin or a button will interfere with the passage of intestinal contents through the opening so long as it remains in position.

5. Rather more bowel is cut off from the general circuit.

On the other hand, the advantages of end-to-end anastomoses are :

1. The two pieces of intestine are united in a direct line.

2. It is the most economical of bowel.

3. Buttons and bobbins can be employed when time is of extreme importance.

4. It takes less time than a lateral operation combined with closure of the ends of the gut.

The disadvantages are :

1. It is more difficult to perform.

2. It is very difficult to insure the apposition of the portions of the gut between the layers of the mesentery.

3. The stitches at the mesenteric border may interfere with the nutrition of the rest of the line of union.

4. There is a great liability to cicatricial contraction producing a stricture.

I am therefore disposed to recommend the lateral anastomosis for surgeons who have not had much experience of intestinal work. I am sure that the surgeon will have much less anxiety and the patient's chances of recovery will be much greater.

I strongly recommend that the various methods of performing anastomoses by suture alone be practised before attempting those which involve the use of any apparatus, since a thorough knowledge and experience of the methods by simple suture is desirable before using an apparatus.

Section III

LATERAL ANASTOMOSIS

General Directions.—I have already referred to the importance of selecting movable portions of bowel for a lateral anastomosis, but there is another point of equal importance to bear in mind, and that is to insure that the direction of the peristaltic waves should be the same in the afferent and efferent portions of the gut.

If the two pieces of a loop of gut be placed together, as shown in the left-hand drawing in Fig. 25, the result will be that the intestinal contents will be forced in the

direction of the arrow through the opening, and will then meet with waves of peristaltic contraction, which are in the opposite direction. This might tend to force the contents back through the opening.   It is therefore neces-
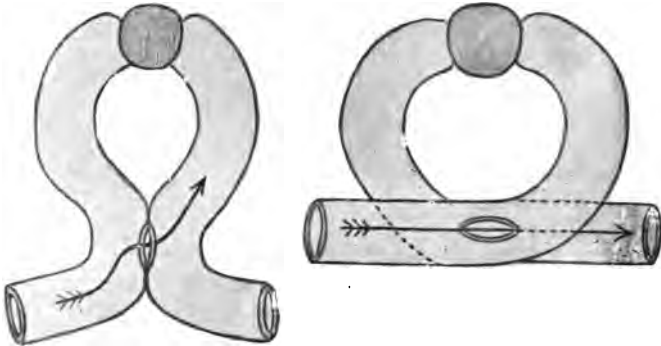
FIG. 25.—THE METHOD OF APPLYING TWO PIECES OF BOWEL
IN SHORT-CIRCUITING.   (L. MARK.)

The left-hand diagram shows the wrong way and the right-hand figure the right way to make a lateral anastomosis.   The arrows show the direction of the waves of peristaltic contraction.
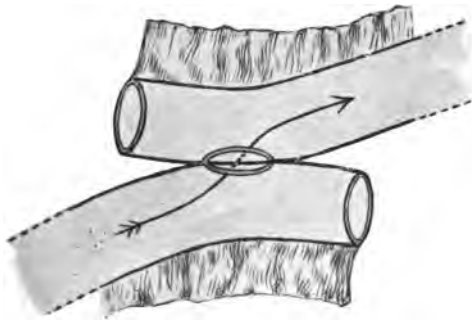
FIG. 26.—THE METHOD OF APPLYING TWO PIECES OF BOWEL TO EACH
OTHER AFTER ENTERECTOMY.   (L. MARK.)

sary to give the loop of the gut a half-turn before uniting the two portions, as shown in the right-hand drawing. If this is done, the waves of peristaltic contraction will be in the same direction in both afferent and efferent portions

of gut, and the intestinal contents will go in the right direction after passing through the new openings. If the anastomosis is to be made after excision of a piece of bowel, the two pieces of gut must be placed side by side as shown in Fig. 26, the two cut ends being on opposite sides of the anastomosis. The next point is that the anastomosis should be made at some distance from the divided end of the bowel or from the seat of obstruction. It is better to allow at least 2 inches between the end of the anastomosis and the point at which the gut will be divided. This makes the necessary manipulation of the bowel easier, and also allows sufficient space for closing the cut ends and insuring that there is an interval between the line of sutures of the anastomosis and that of the occlusion of the cut end. The last point to bear in mind is that the opening is to be made on the convex border of the bowel.

The management of the mesentery in lateral anastomosis does not present any difficulty, since the line of union is at some distance from it. If the operation is simply a short-circuiting one, and occlusion of the bowel is unnecessary, the mesentery will not be touched; but when a portion of the bowel has to be resected, the mesentery should be ligatured close to the portion of the bowel removed in the same way as described in end-to-end anastomosis. When the anastomosis is complete, the pieces of mesentery will lie over one another, and should be united with a few points of suture.

In cases where occlusion is necessary after lateral anastomosis the bowel is divided between clamps about 3 inches from the anastomosis, and each end is closed. This may be done by two rows of sutures as directed for closing a wound of the gut, but a simpler and quicker way is to insert a purse-string suture of catgut, passing

through all the coats right round the gut close to its cut
end, being careful to pick up the peritoneum on each side
of the mesentery ; this is tied tightly, puckering up the
end of the gut, as is shown in Fig. 27.   The purse-string
suture also has the effect of stopping all hæmorrhage, and
the clamp may with advantage be removed after this
is tied.   About three Halsted's or modified Lembert
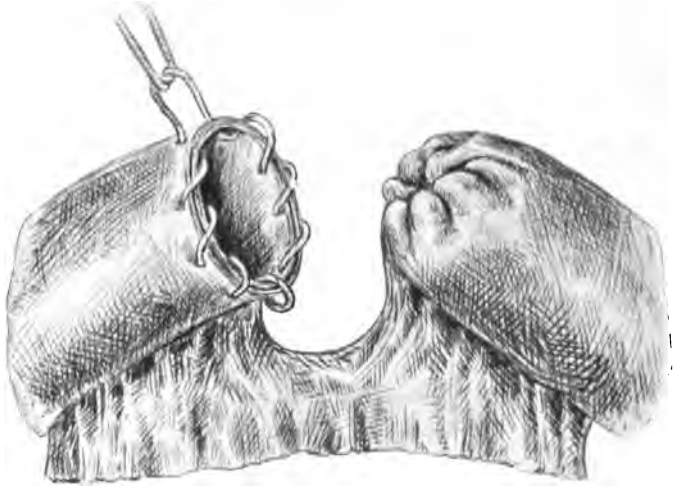
FIG. 27.—OCCLUSION OF INTESTINE.   (L. MARK.)
On one side the purse-string suture has been passed, and on the other
it has been tied, puckering up the end.

sutures will then completely invaginate this stump of gut
and complete the occlusion.

It is important to pass the first invagination stitch
$\frac{1}{2}$ inch at least from the end of the gut, and it should be
inserted as close as possible to the mesentery ; its loop
must be passed over the cut mesentery, and not over the
end of the bowel, and the stitch must be tied before the
others are inserted.   This is shown in Figs. 28 and 29.

1. **Halsted's Method.** — The great advantage of this
method is that all the stitches are passed before the gut

is opened, and this minimizes the risk of fæcal extravasation ; it also facilitates the passage of the sutures. The disadvantage is that the union is effected by a single row
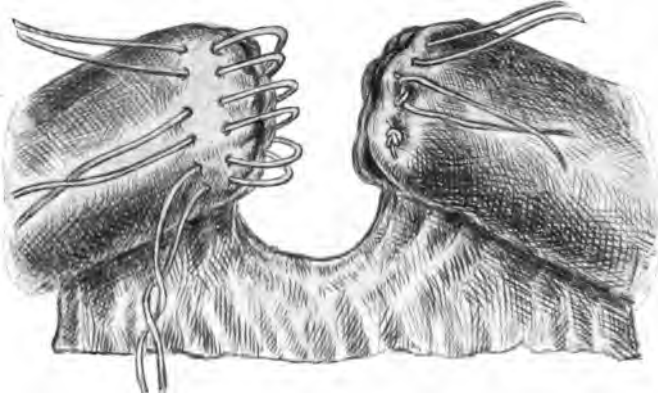
FIG. 28.—OCCLUSION OF INTESTINE. (L. MARK.)
On the one side the invaginating stitches have been passed but not tied ; the other side shows the occlusion complete. Note the stitch nearest the mesentery has been tied first.
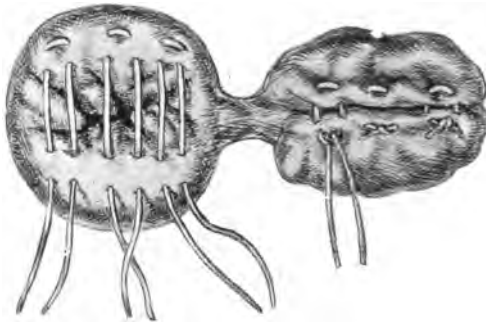
FIG. 29.—OCCLUSION OF INTESTINE. (L. MARK.)
The passage of the invaginating stitches seen from above.

of stitches, and that, theoretically, infection of the bowel coats may take place. In my experience, however, it has proved absolutely trustworthy ; in no case of operation

by this method has any leakage occurred through failure
of the line of union.

The operation is performed as follows :

Two dozen straight needles should previously be
threaded with fine silk, and be within reach of the
surgeon's hand.

The two pieces of gut between which it is desired to
make an anastomosis are then brought outside the
abdomen and placed against each other in such a position
as to secure iso-peristalsis, as pointed out above. Six
square or quilt sutures are inserted in a straight line
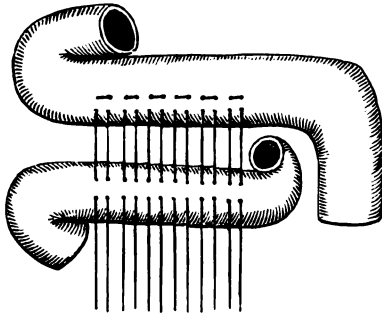
FIG. 30.—HALSTED'S METHOD. (JESSETT.)
The passage of the posterior row of sutures.

midway between the mesenteric and convex borders of
the knuckles of intestine ; the two threads of each stitch
should be $\frac{1}{8}$ inch apart, and the stitches themselves should
be $\frac{1}{4}$ inch apart. These are all passed, and their ends
clamped with pressure forceps before any are tied, so as
to insure the line being straight ; they are then tied and
the ends cut short. At each end of this posterior row of
sutures, and nearer the convex border of the intestine,
two lateral square stitches are inserted ; they are passed
by inserting the needle at an angle of 45° with the
posterior row.

Care must be taken that these lateral stitches are not more than ⅛ inch from the posterior row, and that they are not more than ⅛ inch apart.

The method of passing these is shown in Fig. 31. These stitches are tied, and the ends cut short. A gutter will now be formed. The knots of all these stitches will be inside the anastomosis.

The anterior row of sutures must now be passed, and the first one at each end must extend beyond the lateral sutures, so as to completely bury the knots. These two end stitches should be passed first, and if they be held
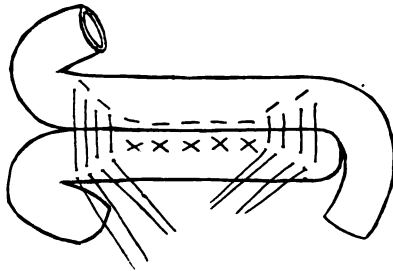
FIG. 31.—HALSTED'S METHOD, SECOND STAGE.
The corner stitches have been passed at an angle of 45° to the posterior row.

apart by an assistant they will act as guides, and a definite ridge will be formed on each portion of the gut, which will facilitate the passage in a straight line of the rest of the row of stitches. About nine to twelve of these stitches will have to be passed, as the anterior row is much longer than the posterior. They are not tied, but their ends are clamped with Spencer Wells forceps. Clamps are now applied to the intestines on each side of the anastomosis, and two blunt hooks are introduced in the middle of the row of sutures, and the threads are drawn aside so as to expose the two portions of intestine included within the sutured area. An opening is now made in each piece of

gut with a scalpel, and enlarged with scissors to nearly the whole length of the line of stitches. This is shown in Fig. 32. The bleeding will be very slight, and probably
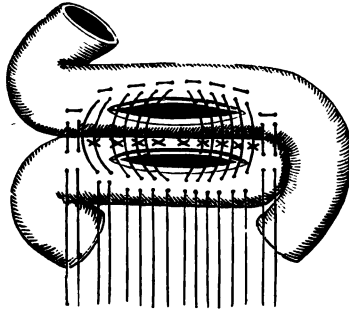
FIG. 32.—HALSTED'S METHOD. (JESSETT.)
All the sutures have been passed, and those of the posterior row have been drawn aside to permit the openings to be made.

no point will require ligature, since any oozing will stop when the sutures are tightened. The opening should be made in the collapsed portion of gut first, so as to lessen
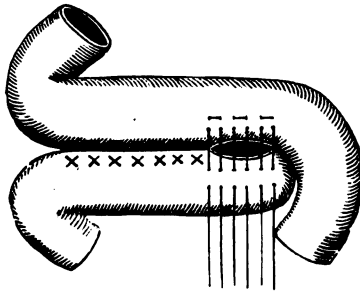
FIG. 33.—HALSTED'S METHOD, FINAL STAGE. (JESSETT.)
All but the last three sutures have been tied.

the danger of extravasation. When both openings have been made and bleeding-points ligatured, the blunt hooks are removed and the sutures tightened by pulling on the forceps ; the stitches are then tied under a stream of

normal saline solution. When all are tied, the ends are cut off, and the anastomosis is complete.

Although Halsted's method is easy after a little practice, I have found that beginners have great difficulty in managing the lateral sutures, and that the method of a double row of sutures with guides is easier to master.

2. **Lateral Anastomosis by Two Rows of Interrupted Sutures.**—The two pieces of gut are placed in apposition, taking care to secure iso-peristalsis.
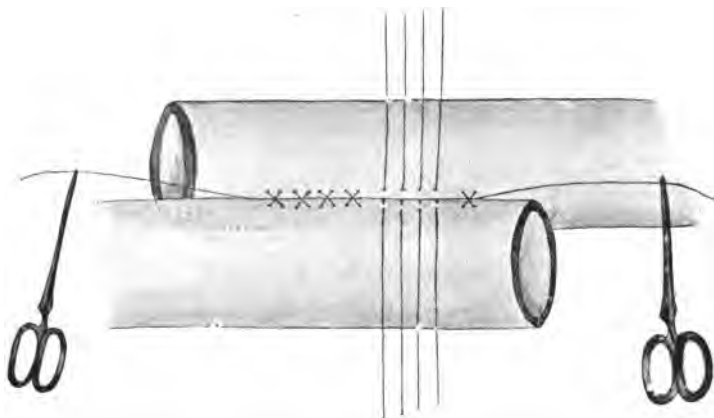
FIG. 34.—LATERAL ANASTOMOSIS BY INTERRUPTED STITCHES. Passage of the first row of Lembert's.

Two Lembert guides are inserted, about 2 inches apart and ¼ inch from the convex border of each loop of intestine on the side where their mesenteries are in contact. These sutures are tied and held apart, and thus produce a well-marked ridge, along which the row of Lembert sutures can be passed with great ease. This is seen in Fig. 34. When the row of Lembert sutures is completed, clamps are applied to the bowel on each side of the line of suture, and an incision 1¾ inches long made

in each loop of intestine about ¼ inch from the line of Lembert sutures.

Two new catgut guides are now inserted through all the coats, being passed from the mucous to the serous coats on one side, and from the serous to the mucous coats on the other. They are tied with their knots on the mucous surface. This is shown in Fig. 35. They are then held apart by the assistant, and a row of stitches are passed through all the coats and tied with their knots on the
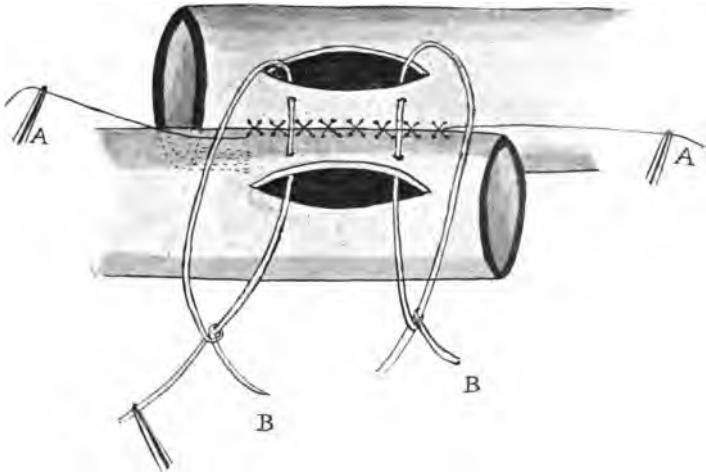
FIG. 35.—LATERAL ANASTOMOSIS BY INTERRUPTED SUTURES.
A, Lembert guides ; B, guides for stitches going through all the coats.

mucous surface. The catgut guides are now cut off, and the anastomosis again held up by the Lembert guides. The anterior edges of the opening in each piece of bowel are now united with a row of stitches passing through all the coats with their knots on the mucous surface. Care must be taken that, in turning the corner, the interval between the stitches does not exceed ¼ inch. This is best effected by passing the needle directly towards the angle of the incision from the mucous to the serous coats, and

directly towards the centre of the incision from the serous to the mucous coats. The line of suture also must not be finished off at a corner, so it is best to commence the line of suture from each end, and finish off in the centre. The penultimate stitch must not be tied until after the last stitch has been passed. When this row of sutures is complete, a row of Lembert's sutures must be inserted over them. In order to obtain a proper ridge for the insertion of the Lembert stitches, two new Lembert
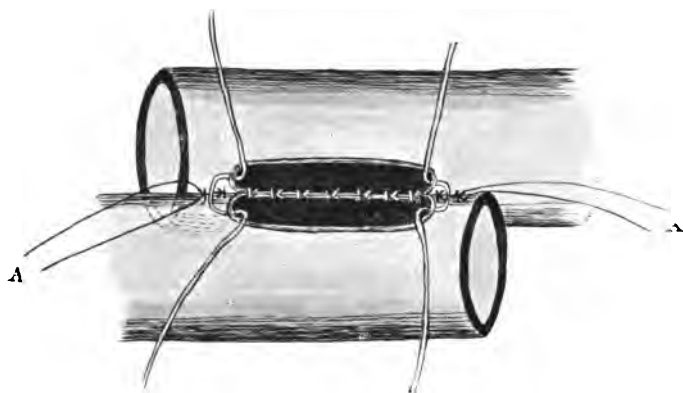
FIG. 36.—LATERAL ANASTOMOSIS BY INTERRUPTED STITCHES.
Posterior double row of sutures completed; passage of anterior row of sutures going through all the coats. A, Lembert guides.

guides are required. They should be inserted about $\frac{3}{4}$ inch inside the original Lembert guides, and $\frac{1}{4}$ inch from the line of suture. These should be tied, and when held apart will form a perfect ridge through which the Lembert's suture is inserted. A row of Lembert's sutures will also be required on each side of the row between the new and old guides.

3. **Lateral Anastomosis by Continuous Sutures.**— The two loops of intestine are placed in a position of iso-peristalsis, and two Lembert guides are inserted as
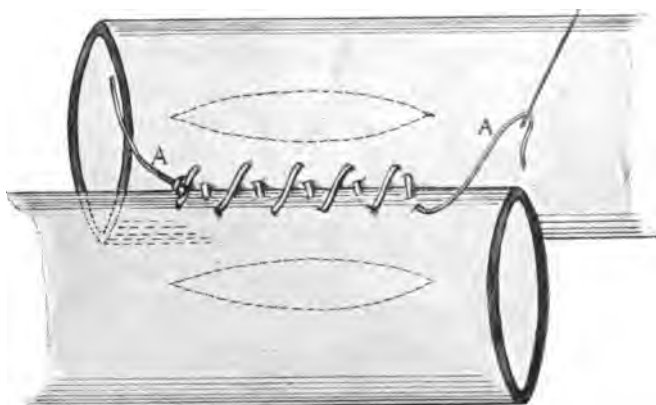
FIG. 37.—LATERAL ANASTOMOSIS BY DOUBLE CONTINUOUS SUTURES.
A, Posterior continuous Lembert suture.   The guides are
not shown ; they are similar to those in Fig. 34.
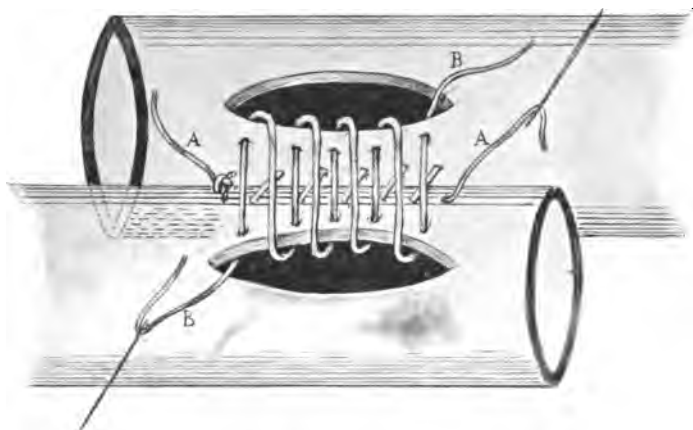
FIG. 38.—LATERAL ANASTOMOSIS BY DOUBLE CONTINUOUS SUTURES.
The openings have been made, and the posterior part of both sutures
have been passed.

A, Continuous Lembert ; B, continuous suture passing through all coats,
which has not been tightened for the sake of clearness.

in the former method ; both ends of one guide and one
end of the second are clamped with artery forceps, and
are held apart by the assistant, and with the end of the

second guide a continuous Lembert is inserted between the two guides. It is oversewn every fourth stitch, and is finished off by tying it to the first guide.

Clamps are now applied to the bowel on each side of the anastomosis, and an incision about 1¾ inches long is made in each loop of intestine about ¼ inch from the line of the continuous suture. Catgut guides are now inserted into the opposite edges of the two openings, and are tied with their knots on the mucous surfaces; these are clamped with forceps, and held apart while, with the
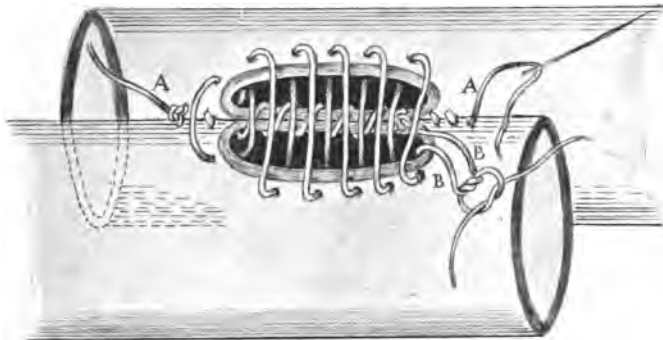
Fig. 39.—Lateral Anastomosis by Double Continuous Sutures.

A, Lembert suture; B, the suture passing through all coats has been carried completely round the opening, but has not been drawn tight.

long end of one of the guides, a continuous catgut stitch is carried through all the coats and finished off by tying to the other guide.

In passing this suture, care must be taken not to include the peritoneal stitch in it, and the suture must be oversewn at every fourth stitch. When the union of the posterior edges is completed, the catgut guides are cut short, and the anastomosis held up by the Lembert guides while the anterior edges are united by a continuous catgut suture; care should be taken to commence each

stitch from the mucous surface, then pass it from the serous to the mucous of the opposite edge, and to pull it tight as it comes out of the mucous surface again ; this inverts the cut edge.   When the whole circumference of the new opening is sewn up, the suture is tied to the end of the first catgut guide, with which a few stitches have been made, so as not to finish off the suture at a corner.

After tying, both ends are cut to a length of $\frac{3}{8}$ inch, and the knot tucked inside the mucous membrane.   This is most easily done by seizing the ends with a pair of sinus forceps, and pushing them within the anastomosis.   The clamps can now be removed from above and below the anastomosis.   Two new Lembert guides must be inserted, $\frac{3}{4}$ inch inside the original guides, and a continuous suture passed between them.   A continuous Lembert suture will also have to be passed between the new and old guides on each side, and this will complete the double row of sutures.

This method is a little more rapid after practice, but requires great care to prevent eversion of the mucous membrane.   It is also most important to keep the thread taut while passing the sutures.

4. **Lateral Anastomosis by Clamps.**—The method of performing a lateral anastomosis by clamps, as advocated by Moynihan and others, is as follows :

Either a double clamp is used, as shown in Fig. 40, or two long straight clamps with bowed blades ; these are made to pinch up a good-sized fold of the two pieces of gut to be united.   The clamps are then held side by side, with a roll of gauze between them, and beneath the proposed line of union, to prevent any intestinal contents tracking into the abdomen.   A continuous serous suture is now inserted, uniting the two pieces of gut held within the clamps. This is shown in Fig. 41.   An incision is next made into each piece of intestine, $\frac{1}{4}$ inch from the line of the con-

tinuous serous stitch. A through-and-through catgut suture is now passed, uniting the cut edges of the gut; this is continued right round the anastomosis and tied to
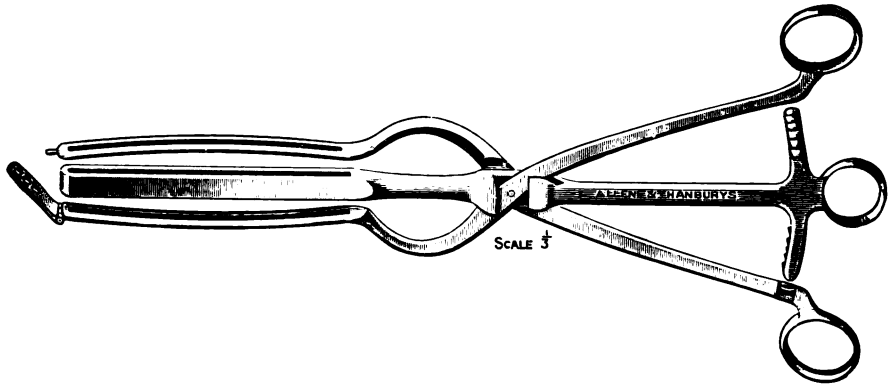
FIG. 40.—DOUBLE CLAMP FOR LATERAL ANASTOMOSIS.
(ALLEN AND HANBURY.)
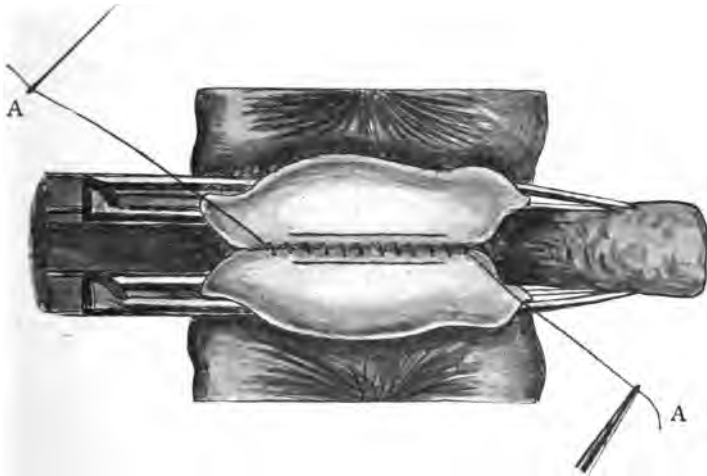
FIG. 41.—LATERAL ANASTOMOSIS BY CLAMPS.
A, Continuous Lembert completed. Position of the openings is shown.

the end left at its commencement, and its knot tucked inside. This is shown in Fig. 42. A continuous serous suture stitch is now inserted over the anterior part of the
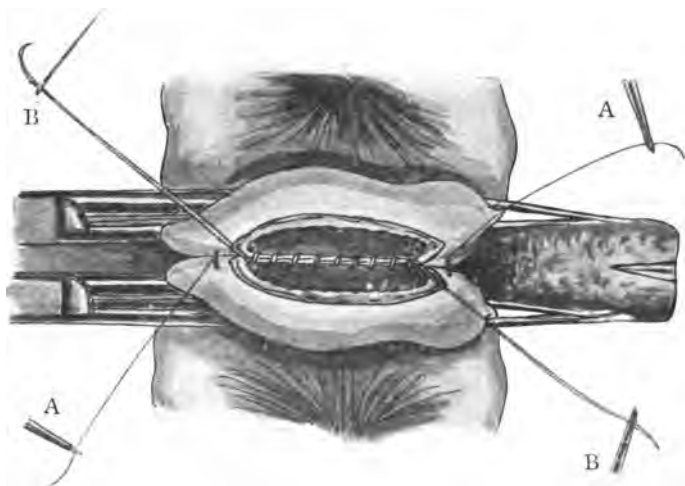
FIG. 42.—LATERAL ANASTOMOSIS BY CLAMPS.
A, Continuous Lembert; B, posterior continuous suture completed.
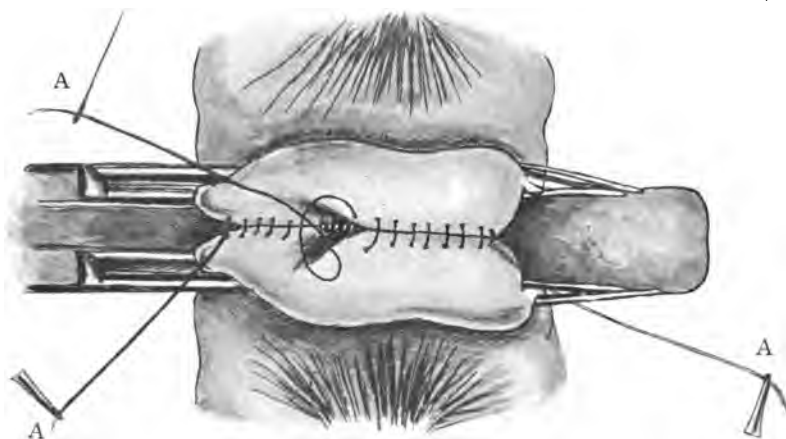
FIG. 43.—LATERAL ANASTOMOSIS BY CLAMPS.
A, Continuous Lembert half completed; B, continuous suture through all the coats completed.

anastomosis, completing the line of union. This is shown in Fig. 43. The clamps are now removed, and the roll of gauze is pulled out.

CHAPTER III

END-TO-END ANASTOMOSIS

THE first consideration is the management of the mesen-
tery. There are two ways of treating this : (1) A **V**-shaped
piece is cut away corresponding to the knuckle of intestine
removed, the vessels being tied as divided, and the sides of
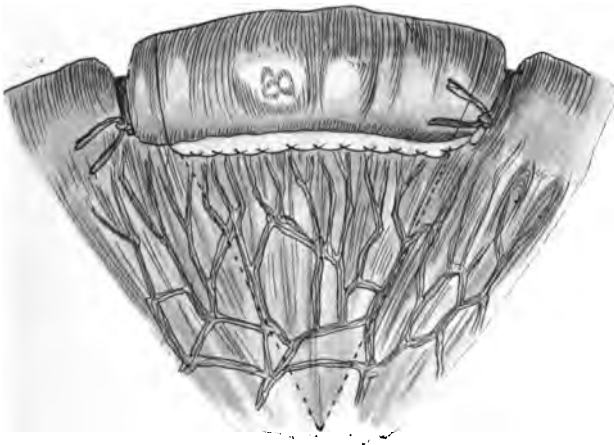
FIG. 44.—MANAGEMENT OF THE MESENTERY. (AFTER CHEYNE.)
The dotted line shows the incision when a V-shaped portion is removed.
    In the figure the mesentery has been divided and ligatured close
    to the bowel.

the **V** being brought together after the anastomosis is com-
pleted. This is open to the objection that it entails some
interference with the blood-supply of the divided ends of
the gut, and, moreover, it may be difficult to pick up bleed-

45

ing points at the bottom of the **V** close to the root of the mesentery. It is used only in cases of cancer or of gangrene from thrombosis of the mesenteric veins. The second method consists in dividing the mesentery close to and parallel with the loop to be removed, and tying the bleeding points.

In order to prevent loss of blood, it is best to divide the mesentery between two pairs of artery forceps. A pair of artery forceps is pushed through the mesentery
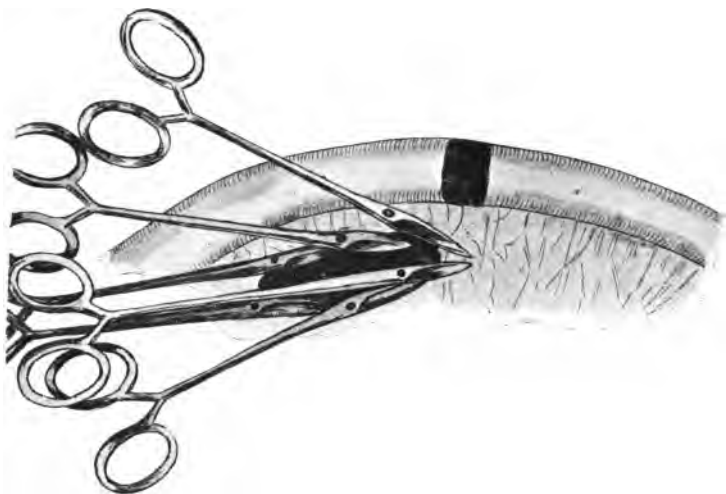
FIG. 45.—METHOD OF DIVIDING THE MESENTERY BETWEEN CLAMPS.

about ½ inch from the gut, and a small hole torn in the mesentery ; two pairs of artery forceps are now put on the mesentery, as seen in Fig. 45, and the mesentery divided between them ; more forceps are put on side by side, and the mesentery cut between them until sufficient has been divided. Care, however, must be taken that the mesentery is not divided beyond the point at which the bowel is to be cut, since this would interfere with the vitality of the cut end of the gut.

When the anastomosis is complete, a redundant fold of mesentery will be left, which must be sewn over with a continuous suture, as shown in Fig. 46, so as to avoid leaving a hole through which a loop of gut might pass and become strangulated.

The second consideration is to avoid cicatricial contraction of the new opening. This is minimized by dividing the gut obliquely, so as to remove about $\frac{1}{2}$ inch more of the convex than of the mesenteric border ; this,
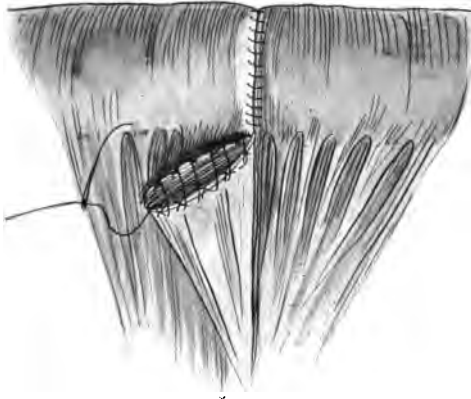
FIG. 46.—MANAGEMENT OF THE MESENTERY. (AFTER CHEYNE.)

The edge of the redundant portion of the mesentery has been closed with a continuous suture, and is then to be sewn down to the mesentery beneath it.

of course, leaves a much wider line to be sutured, and so lessens the chance of contraction. It, moreover, has the advantage of removing the portion of the intestinal circumference which is furthest removed from the bloodsupply, and so would be unlikely to unite quickly (see Fig. 47).

The last consideration is that the mesenteric portions of the two pieces of intestine must be brought most accurately in apposition, as the absence of peritoneal

covering for about ½ to ¾ inch of the circumference of the gut at this point makes it essential that the other stitches should be accurately applied.

The anastomosis may be effected by—

    I. A single layer of interrupted sutures.
   II. Two layers of interrupted sutures.
  III. Two layers of continuous sutures.
  IV. Apparatus and sutures.
   V. Apparatus alone.

Under (I.) we may use either a row of Lembert's sutures or one of Halsted's quilt sutures, but neither
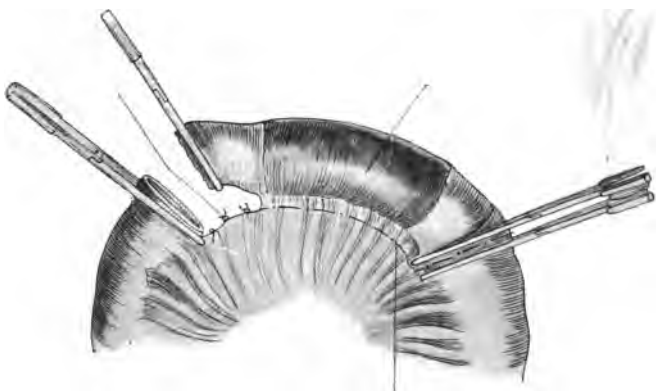
FIG. 47.—SHOWING THE OBLIQUE SECTION OF THE BOWEL IN CASES OF END-TO-END ANASTOMOSIS. (AFTER KOCHER.)
The mesentery is being divided close to the bowel.

method is likely to be satisfactory, as it is difficult to pass the stitches so as to prevent any protrusion of the mucous membrane, and, owing to the strain which will be imposed on these Lembert stitches, especially should any of them have been improperly passed, there is a considerable danger of their cutting out, and of a leak occurring in the anastomosis. It is therefore practically impossible to perform an anastomosis with a single row

of stitches, unless these stitches penetrate all the coats
of the bowel, in which case their knots must be on the
mucous surface. Thére are two methods of effecting
such an anastomosis which are worthy of notice, those
of Maunsell and Connell.

In these methods the sutures are passed through all
the coats of the bowel, but all the knots are inside the
mucous membrane. As before mentioned, it does not
much matter if the suture penetrates through all the
coats of the intestine if the knot is inside, since the suture
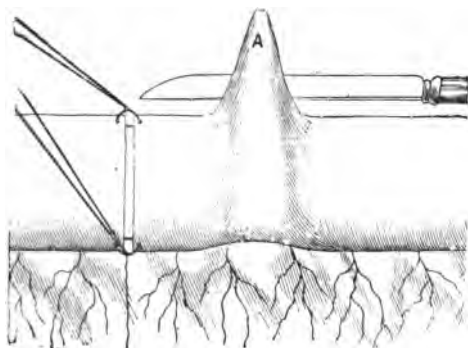
FIG. 48.—MAUNSELL'S METHOD. (MAUNSELL.)

The sutures uniting the mesenteric and convex borders should have
been shown passed so that their knots were inside. The bowel
is being opéned below the anastomosis.

tends to separate in the direction of its knot, and the
danger of extravasation lies in the communication estab-
lished after separation of the sutures rather than in any
infection tracking along the stitch. Infection tracking
along the thread will produce adhesions, and these may
give rise to subsequent trouble. This is the real danger
of these methods.

In **Maunsell's Method** a temporary intussusception is
produced, in order to pass and tie all the sutures.

The mesenteric and convex borders of each piece of

4

gut are united by two sutures passed through all the coats, and with their knots inside the mucous membrane ; they should be tied loosely, and their ends left long. A vertical incision is then made in the convex border of the lower segment of the bowel about 1½ to 2 inches below its cut end, and of the same length as the diameter of the bowel at this point. A pair of clamp forceps are introduced through this incision, and the ends of the two guiding sutures are seized and brought through the incision in the convex border. On pulling on these sutures, the two ends of the gut will be invaginated through the
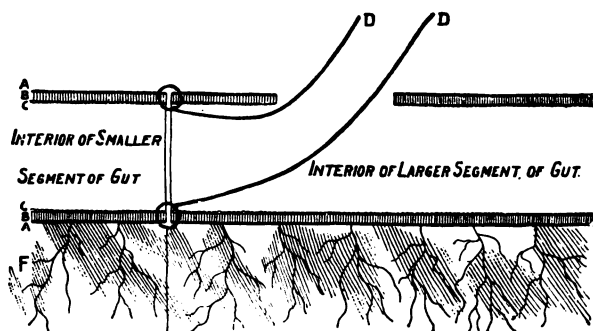
FIG. 49.—MAUNSELL'S METHOD. (MAUNSELL.)

The traction stitches have been brought out of the new opening.

incision, and the upper portion will be inside the lower, the serous surfaces being in apposition. The opposite serous surfaces are clamped together in their centre, and a row of interrupted sutures about ⅛ inch apart are inserted all round the opening. Each suture is tied tightly, and its ends cut short. Care must be taken that the mucous membrane does not become everted between the two serous surfaces. Maunsell recommends that the needle should be passed through both sides of the anastomosis—*i.e.*, through all the four thicknesses of gut—and the loop of silk picked up in the centre, thus

passing two sutures in one. I do not, however, recom-
mend this, as there is a risk of not picking up one of the
pieces of the intestine, and one cannot be so certain of
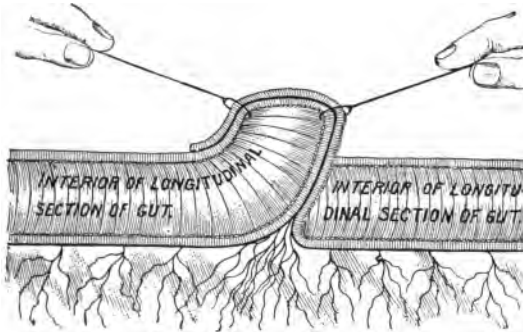
FIG. 50.—MAUNSELL'S METHOD. (MAUNSELL.)
The intussusception has been produced by pulling on and separating
the traction stitches.
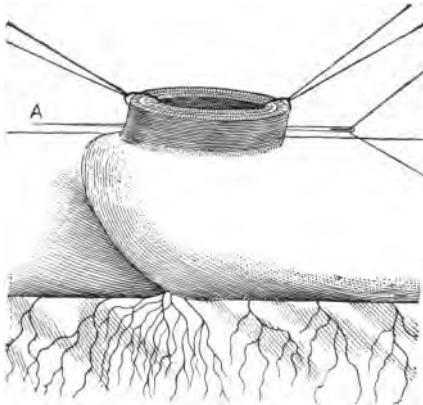
FIG. 51.—MAUNSELL'S METHOD. (MAUNSELL.)
The needle A is being passed through both sides of both pieces of bowel.

preventing eversion of the mucous membrane. More-
over, the manœuvre is not easy with collapsed intestine.

After all the sutures have been passed and tied, the
gut is pulled out straight, and the peritoneal surface

of the line of sutures is examined carefully to see if the suturing is perfect. If any mucous membrane is seen, it is snipped off, and a Lembert suture is passed over the spot. In order to make the union more secure in the cases where I have employed the method, I have passed a row of Lembert sutures all round the anastomosis, but this has the effect of producing some narrowing of the opening.

It now only remains to close the incision in the intestine below the anastomosis, which is done by a row
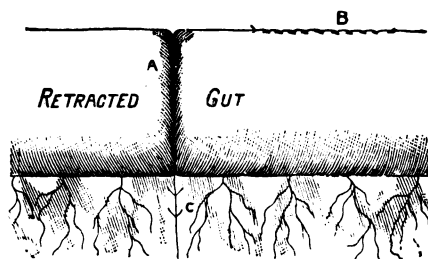
FIG. 52.—MAUNSELL'S METHOD. (MAUNSELL.)
The suture is complete, the intussusception has been reduced, and the opening in the bowel below (B) has been closed.

of Lembert sutures, or of Halsted's sutures. If time permits, a double row of sutures is preferable.

Connell's Method. — In this method the two pieces of gut are united by a single row of mattress stitches passed through all the coats, with their knots on the mucous surface. The first stitch is passed at the mesentery. It is passed from the mucous surface of one piece of gut and brought out of the serous surface close to the mesentery; it is then inserted into the serous surface of the other portion of intestine close to the mesentery; it is brought out of the mucous membrane, and reinserted from the mucous to the serous surface on the other side; it is finally inserted from the serous to the mucous surface

on the first piece of intestine. This is shown in Fig. 53. This stitch is tied. The stitch is quite satisfactory when operating on the upper part of the small intestine, where there is little interval between the layers of the mesentery, but in the lower part of the ileum, where the interval is larger, the stitch does not at all effectively unite the portion of the gut between the layers of the mesentery. A similar stitch should then be passed through the convex borders of both portions, and the piece of gut held up by
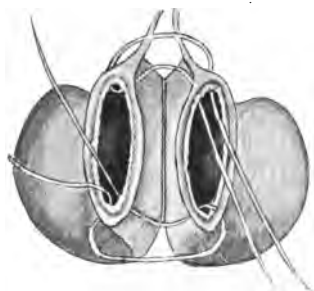
FIG. 53.—CONNELL'S METHOD.
Passage of the mesenteric stitch and of a guide at the convex border.

this and the first stitch ; it will then be easy to pass a row of mattress sutures, as shown in Fig. 54.

On the other surface, it is a little more difficult to pass the mattress sutures, as we have to remember to keep their knots on the mucous surface.

Each stitch must be commenced on the mucous surface of one piece of gut, then passed from the serous to the mucous surface of the second piece of gut, then reinserted, at an interval of $\frac{1}{8}$ inch, from the mucous to the serous surface, and finally inserted from the serous to the mucous surface on the first piece of gut. It is easy to get all these knots inside, with the exception of the last one. This, however, can be done in the following way : A threaded
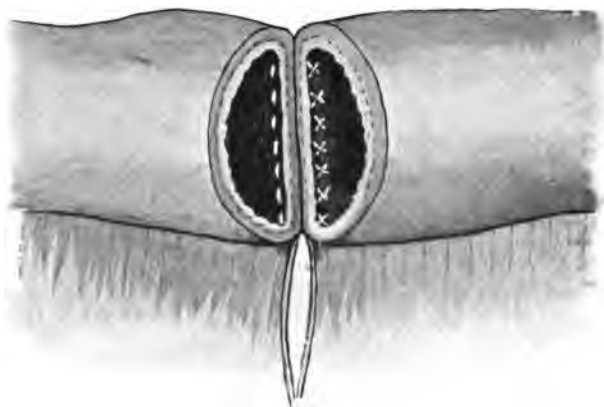
FIG. 54.—CONNELL'S METHOD.
First row of sutures passed and tied.

FIG. 55.—CONNELL'S METHOD.
Way of getting the knot of the last stitch inside the mucous
membrane.

needle is pushed with its eye forward between two of
the stitches; this traverses the bowel, and is made

to emerge at the point where the last stitch has been passed. The two ends of the last stitch are now passed between the thread and the needle, as shown in Fig. 55. The needle is then pulled out, dragging the end of the last stitch through the line of union at a point opposite to that at which it had been inserted. It is then tied, its ends cut off, and its knot will be found to be on the mucous surface. This method leaves a firm union, but as adhesions would be likely to form in the neighbourhood of the stitches, since they have penetrated all the coats, it is advisable to insert a supporting row of Lembert sutures.

II. **The Method of Anastomosis by Two Layers of Interrupted Sutures** is a very good one, and is usually done by the Czerny-Lembert or Wölfer's method. In order to insure that corresponding portions of the circumference of the two pieces of intestine are united together, it is best to insert two Lembert's sutures between each piece of gut, one at the convex border, and the other close to the mesenteric attachment, about $\frac{1}{4}$ inch from the free edge. These are not tied, but the central portion of the thread is pulled out, and each stitch clamped with forceps, and so, when these stitches are held apart, they will define a line for the insertion of the row of interrupted sutures, and will raise up a ridge on the serous surface, which renders the introduction of the Lembert's stitches more easy. These guides are shown in Fig. 56. The two pieces of gut must now be turned over in order to insert a row of interrupted sutures going through all the coats of the bowel, whose knots will be on the mucous surface. These are all tied, and the ends of the sutures cut short, with the exception of that nearest the mesentery, which is left long. This is marked 2 in Fig. 57. The united piece of gut is then turned over, and a row of Lembert's stitches inserted along the ridge raised by the guiding sutures.
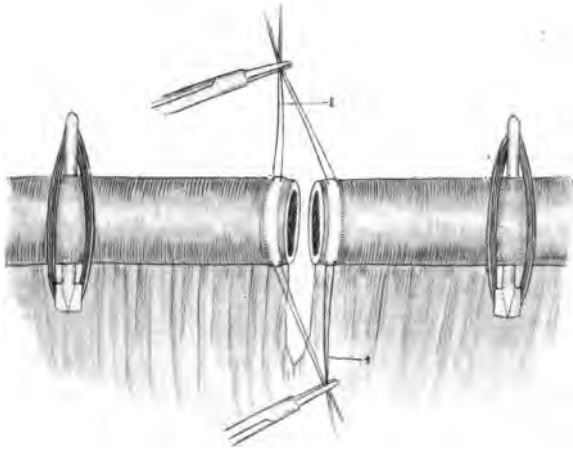
FIG. 56.—END-TO-END ANASTOMOSIS.

1, Suture passed through the convex border of adjacent pieces of gut;
4, sutures passed close to the mesentery. Two Lane's clamps
are seen in position.

FIG. 57.—END-TO-END ANASTOMOSIS.

The pieces of bowel re held up by threads 1 and 4, by means of the
intestine-holder. The row of sutures uniting all the coats has
been passed, and the one next to the mesentery (2) has been left
long and clamped.

The guide next to the mesentery is then unclamped, its
central part let go, and the stitch is tied and its ends cut
short. A new serous guide is inserted close to the

mesentery on the other side of the gut (marked 3 in Fig. 58).

The central part of this stitch is pulled out, and the ends clamped together with forceps. Another pair of forceps is placed on the long ends of the suture (No. 2), which had been inserted on the inside of the bowel,
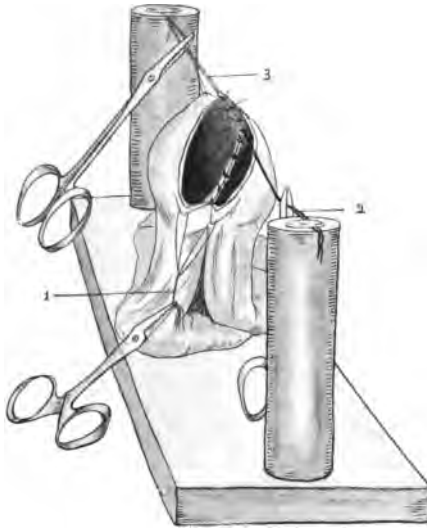
FIG. 58.—END-TO-END ANASTOMOSIS, SHOWING THE METHOD OF UNITING THE PORTION OF THE INTESTINE WITHIN THE LAYERS OF THE MESENTERY.

2, Last stitch of row of through and through sutures ; 3, Lembert suture passed at corresponding points of the two ends close to the mesentery, but on the other side of the bowel to that marked 4 in the preceding figures.

close to the mesentery. On holding apart these two forceps, the portions of each piece of gut between the layers of the mesentery will be accurately held in apposition, and are united together by a row of interrupted sutures passed through all the coats, their knots being tied inside the bowel. This is shown in Fig. 58. All these sutures are cut short, including the one which acted as

a guide. The guide first inserted in the convex portions of the bowel is now again seized with forceps, and held apart from that passed close to the mesenteric attachment. This is to show the line for the insertion of the sutures on the third side of the triangle. This portion of the anastomosis is completed in the way described before for the closure of a wound in the bowel—
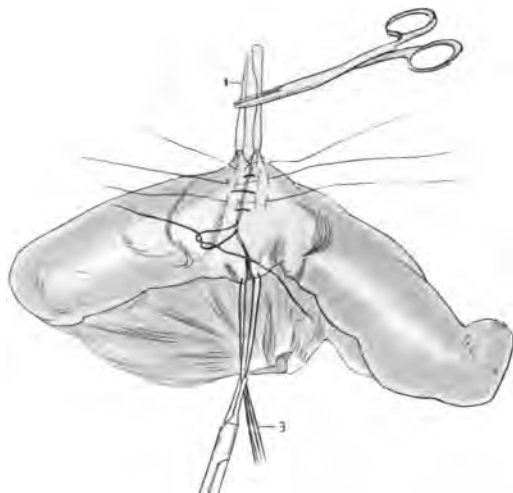
FIG. 59.—END-TO-END ANASTOMOSIS.

The numbers refer to the same threads as in the preceding figures. Closure of the third side of the triangle by two layers of interrupted stitches, in the same way as described in Figs. 20 and 22.

i.e., by a double row of sutures, the one composed of stitches passing through all the coats, and tied with their knots inside the lumen of the gut, and the other a row of Lembert's. When these are inserted, the two guides are tied. The operation is completed by the insertion of a mesenteric stitch.

One of the strongest is the following : An ordinary Lembert stitch is inserted in the mesentery ¼ inch from

the margin of the gut and from the divided edge. It is then inserted in a similar position on the opposite side, and the needle is carried through the whole thickness of the mesentery, and a Lembert stitch is inserted on the other surface of the mesentery on each side. The needle is then again carried through the whole thickness of the
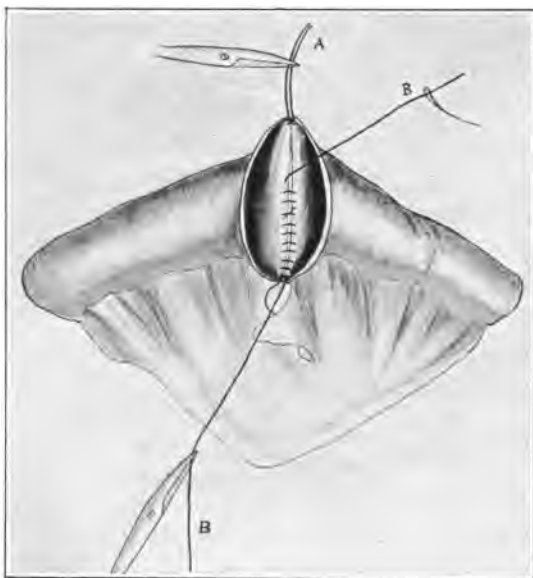
FIG. 60.—END-TO-END ANASTOMOSIS BY DOUBLE CONTINUOUS SUTURES.

Passage of continuous catgut suture passing through all the coats.

mesentery, and made to emerge at the point of commencement of the stitch. On tightening the stitch the mesentery will be securely approximated on each surface.

III. **The Method by a Double Continuous Suture** is quicker, but it is certainly more difficult to perform, on account of the necessity of keeping each stitch tight while passing the suture, and of preventing puckering.

The following method which I employ for end-to-end

anastomosis consists of a double continuous suture passed between guides, the adjacent pieces of intestine being held tightly stretched while the suture is passed. In this way contraction of the line of union is impossible. It is performed as follows : Two catgut sutures are in-
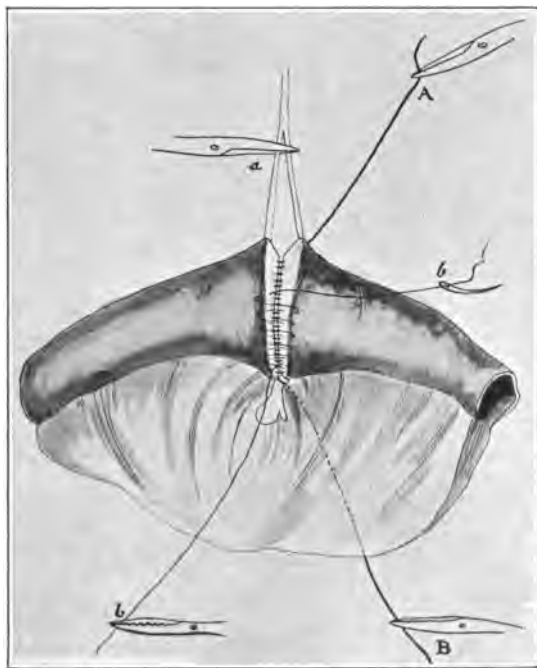
FIG. 61.—END-TO-END ANASTOMOSIS.

Passage of continuous Lembert suture, *b ;* this has not been drawn tight for the sake of clearness. A, B, catgut stitches as in Fig. 60 ; *a*, Lembert stitch with its centre drawn out.

serted—one at the convex border, the other close to the mesentery. These are passed through all the coats of each piece of gut, and are tied with their knots on the mucous surface. Both ends of one suture and the short end of the other are clamped, and by pulling these clamps apart, the line of suture is tightly stretched ; a continuous

suture is then run from B to A with the long end of suture
B (Fig. 60). It is then tied to A and the ends cut off.
The piece of bowel is then turned over and two silk Lem-
bert sutures are inserted, one at the convex border, and
the other close to the mesentery. The one close to the
mesentery, *b*, is tied and its short end clamped; the one
at the convex border is not tied, but its centre is pulled
out, and it is then clamped (this throws up a definite
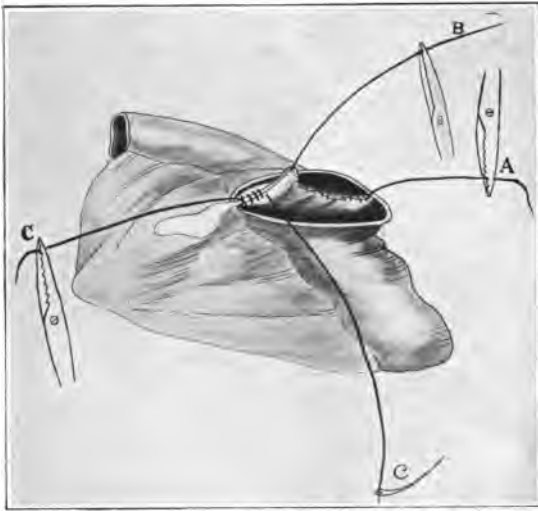
FIG. 62.—END-TO-END ANASTOMOSIS.
Uniting the portion of gut between the layers of the mesentery.
A, B, catgut stitches as in Fig. 60 ; C, continuous catgut stitch.

ridge of peritoneum for the Lembert suture). The two
clamps are now held apart so as to put the edges of the
gut on the stretch, and with the long end of the suture, *b*,
a continuous Lembert suture is run from *b* to *a* (Fig. 61).
It is tied and its ends cut off. The gut is then turned
over again, and another catgut stitch, C, uniting the two
ends of the gut on the opposite side of the mesentery, is
passed through all the coats of each piece of gut, and tied

with its knot on the mucous surface. The short end of
this is clamped, and this is held apart from the end of the
suture B, which was passed first. This makes taut the
portion of the circumference of the two ends of bowel
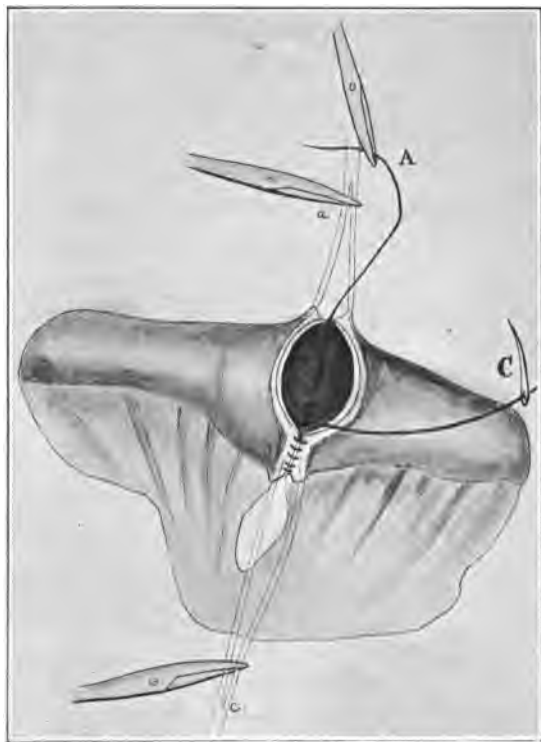
FIG. 63.—END-TO-END ANASTOMOSIS.

Closure of second side with continuous catgut stitch C. Line of suture
held taut by two Lembert sutures, *a* and *c*, which have had their
centres pulled out so as to throw up a peritoneal ridge. A, end
of catgut suture in Fig. 60.

between the layers of the mesentery. A continuous
suture is then passed from C to B, and tied to the end
B, and then cut short (see Fig. 62). A Lembert suture, *c*,
is then passed close to the mesentery, and its centre pulled

out and clamped. The clamps on the sutures *a* and *c* are then held apart (see Fig. 63), and a continuous catgut stitch is passed from C to A, its two ends being tied to the ends C and A respectively, and their knots tucked under the lumen of the gut. The Lembert guides *c* and *a* are then tied, and one end of *c* and both ends of *a* are clamped and held apart, while a continuous Lembert suture is passed from *c* to *a* with the long end of suture *c*, and is tied to one end of *a*. A mesenteric stitch passed ¼ inch below the bowel completes the anastomosis.

The main advantage in this method is that the guides absolutely insure that corresponding portions of each piece of gut are united, and as the various portions of the gut are held tightly stretched by the guides during the insertion of the continuous sutures, these sutures can be pulled absolutely tight without any fear of producing subsequent constriction of the new opening. In passing each stitch of a continuous suture it is essential to pull the thread tight, and to hold it firmly till the next stitch is passed. This operation as described may appear complicated, but it is really simple, and it can be done very rapidly (in about fourteen minutes).

IV. **Anastomosis by Suture + Apparatus**

These methods, again, we may divide into those where there is only a single row of sutures and those where there are two rows.

A single row of sutures is employed with (A) O'Hara's clamp forceps, (B) Laplace's forceps, and (C) Halsted's rubber bag.

Although I question the value of any apparatus in intestinal anastomosis, I will briefly describe the methods.

(A) **O'Hara's Clamp Forceps** consist of two pairs of bow-shaped intestinal clamps, about 4 inches long,

which are united together with a clip. This is shown
in Fig. 64. They can be used for either lateral or end-
to-end anastomoses. In end-to-end anastomosis they
are applied as follows :

One of the clamps is applied on either side of the loop
of gut to be removed, and each is tightly clamped. Care
is taken that each clamp is applied slantingly, and that
its end extends as far as, but not beyond, the mesenteric
border of the gut. The diseased portion of the gut is
now cut away close to each clamp, and the mesentery
treated as described before (*vide* p. 45).

½ Sc

FULL SIZE
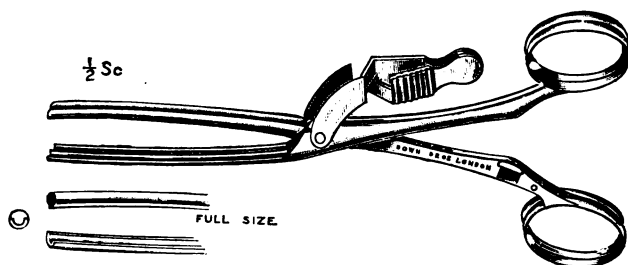
FIG. 64.—O'HARA'S CLAMP FORCEPS. (DOWN BROS.)
The two clamps are fastened together by the spring clip.

The two clamps are now brought together, and are
fixed in contact by their spring clip. A continuous
Lembert suture is commenced at the handle end of each
clamp, bringing the serous surfaces of the two pieces of
intestine together over the blades of the clamp. This
is continued completely around the gut, taking care to
pick up the mesentery of each end in passing. The
clamps are now disconnected, loosened, and withdrawn
separately, and the hole through which they were with-
drawn is closed by the continuous. suture. The anasto-
mosis is now complete. The anastomosis may also be
effected by a row of Halsted's sutures, as shown in

Fig. 65. The objections to this method are (*a*) that a special apparatus is necessary, and will not always be at hand ; (*b*) that a portion of the wall of the gut is apt to slip out from the clamp before the suture is complete ; (*c*) that it is difficult to insure that the continuous suture is tightly applied over the forceps ; (*d*) that adhesions may take place between the cut ends of each piece of gut within the lumen, and cause cicatricial contraction ; (*e*) that a considerable diaphragm will be left at the site of union ; and (*f*) that the portion between the layers of the mesentery is not sutured.
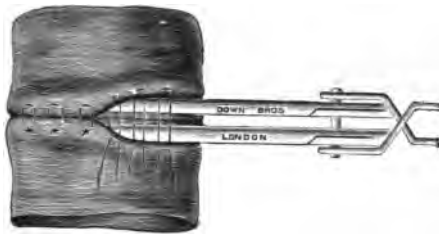
FIG. 65.—METHOD OF PERFORMING END-TO-END ANASTOMOSIS BY HALSTED'S SUTURE OVER O'HARA'S FORCEPS. (DOWN BROS.)

It is, however, easy of application, and does away with the necessity for any other clamping the bowel on either side of the anastomosis, and will prevent any escape of intestinal contents.

(B) **Laplace's Forceps.** — These are shown and de-scribed, because the illustrations and description make them appear very simple. In practice, however, they are not at all easy to apply. The forceps, when united together, consist of two rings between which the ends of the two portions of gut are clamped. Each half of the forceps consists of a semicircular clamp, and they are connected together by a spring clip. In end-to-end anastomosis they are used as follows :

5

The two cut ends of intestine are first united by four fixation stitches passed through all the coats at the four cardinal points—*i.e.*, the mesenteric and convex borders, and midway between these on each side.   These stitches are so passed that their knots will be on the mucous surface.   This insures the exact apposition of the corre-
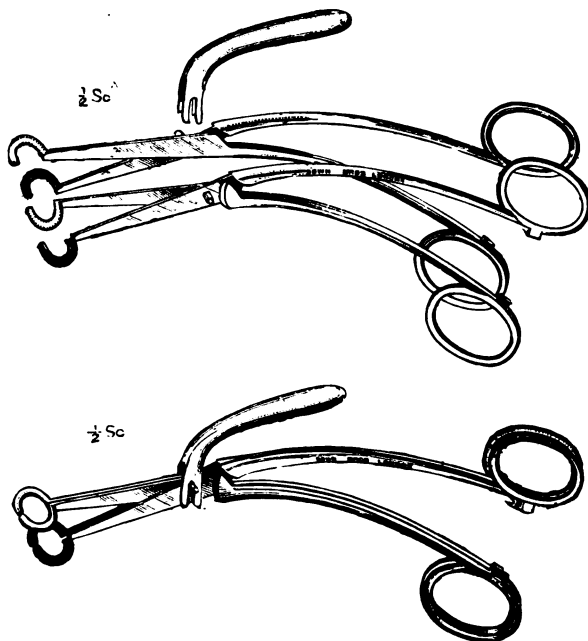
FIG. 66.—LAPLACE'S FORCEPS.   (DOWN BROS.)

The upper figure shows the two clamps separate, and the lower one the two clamps united with the spring clip.

sponding parts of the two ends.   The two halves of the forceps are next introduced separately between two of the sutures, and are then connected together with the clip.

The forceps, which now form a complete ring, are opened so that one ring blade is in each end of the gut.   The serous

surfaces are inverted and drawn between the blades. This is facilitated by passing a ligature round the line of union ; the forceps are then clamped, when serous membrane should be in apposition to serous membrane. The part to be sutured can then be held up by the forceps, and a continuous Lembert's suture is commenced close to the handle of the clamp on one side, and is carried round the intestine to the handle of the clamp on the other side, or Halsted's suture may be used. The clamps are then disconnected, and each half is unclamped and removed separately. The continuous suture is then carried over the hole from which the clamps were removed. The anastomosis is complete.

This method is open to all the objections which I raised to O'Hara's forceps, but it has even a greater fault, and that is, it is often extremely difficult to apply, the trouble being to get the whole of the circumference of the ends of the gut between the blades of the forceps, unless a much larger number than four fixation stitches be first inserted. It is also very hard to get just the right amount of bowel-wall invaginated ; it is easy to get too much, the result being a valve-like projection at the line of suture, which might cause obstruction.

I can find nothing to say in favour of the forceps. I have only included them in my demonstrations, so as to show the difficulties of so-called aids to anastomosis.

(C) **Halsted's Rubber Bag.**—This consists of a rubber cylinder about 2½ inches long, of about the same diameter as the intestine ; a small rubber tube is inserted at its centre, by which the cylinder can be distended (see Fig. 67). It is employed as follows : Four stay sutures are inserted at the four cardinal points of the intestine, each stitch passing through all the coats, and inserted so that its knot shall be on the mucous surface. These are tied,

and the ends cut short. The rubber cylinder is then
introduced in a collapsed state between two of the
sutures, and is then distended and the tube clamped
(see Fig. 68). A row of Halsted's mattress sutures are
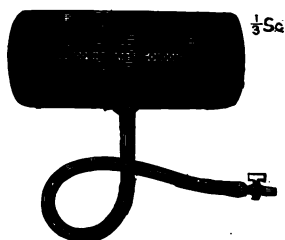
Fig. 67.—Halsted's Air Cylinder. (Down Bros.)
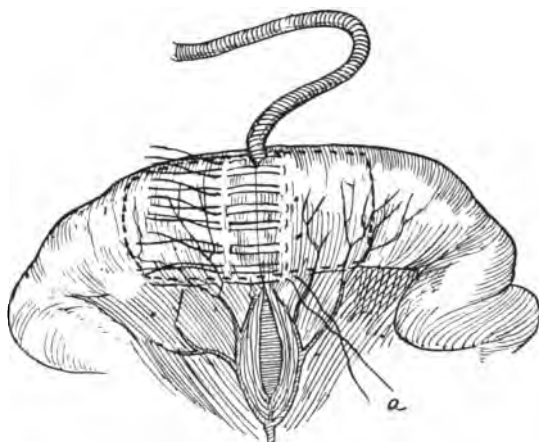
Fig. 68.—Halsted's Air Cylinder in Position. (After Gould
and Warren.)

a, The mesenteric stitch.

then inserted all round the anastomosis, special care
being taken with the stitch at the mesentery, which is
made to penetrate both sides of each piece of mesentery.
All these stitches are tied, with the exception of three
at the centre of the convex border, which are left untied.

The clamp is then taken off the rubber tube, and the collapsed cylinder can easily be withdrawn. The three remaining stitches are then tied, and the anastomosis is complete. A very fine joint is made, and the bag enables the stitches to be passed in a straight line, and makes it easy to pick up the submucous coat. There is also very little contraction of the line of suture. The objections to its use are (*a*) that it is a special apparatus, and may not be at hand when wanted ; (*b*) that the union is effected by a single row of sutures only; (*c*) that the bag may be pricked by a stitch and collapse (this should not occur) ; and (*d*) that the bag is difficult to remove (which is not the case). I consider it a fair method, but very inferior to the method of a double row of sutures with guides.

Anastomosis by Apparatus combined with a Double Row of Sutures

Under this heading are included (1) various bobbins, made of decalcified bone, raw hide, potato, or other substances, and (2) the various clamps, amongst which one would mention Carwardine's and Moynihan's.

Both Mayo Robson's bone bobbin and Allingham's bone bobbin can be used in a similar manner, and the largest-sized bobbin which can be introduced into the intestine should be selected. The chief difficulty about the operation lies in the insertion of the posterior part of the continuous sutures before the introduction of the bobbin. Unfortunately, it is usually necessary to insert both of these before the bobbin is applied, as it is often almost impossible to accurately bring together the serous surfaces of the mesenteric portion of the gut after the bobbin is in position.

The operation with **Mayo Robson's Bobbin** should be performed as follows : Each loop of the bowel is clamped about 2 inches from the cut end. A straight or curved sewing-needle, armed with a long fine silk suture, is then used to unite the serous and muscular coats of the two pieces of gut, commencing about ¼ inch from their mesenteric borders and ¼ inch from their free edges. This is tied at its commencement, and the ends left long. With one end a continuous Lembert or Dupuytren stitch is carried round the posterior part of the line of union. Two stitches are inserted in the direction of the mesentery, and then the stitch is oversewn ; it is then carried through the mesentery to the

FIG. 69.—MAYO ROBSON'S BONE BOBBIN. (DOWN BROS.)

opposite surface, and two stitches are inserted on the opposite surface of the cut ends of the bowel, and the stitch is oversewn. When the suture has been carried to a point ¼ inch the other side of the mesenteries, it is laid aside and clamped. The line of sutures can now be held up by the two ends of the continuous suture, and another needle, threaded with catgut, is now taken, and the mesenteric portion of the two edges of the bowel are united by a continuous suture penetrating all the coats. It is commenced about the same place as the Lembert stitch, and the stitch is tied with its knot inside the mucous membrane, and its ends left long. One end is then used for a continuous suture carried along the mesenteric

portion of the bowel for the same distance as the peritoneal stitch, being oversewn at every third insertion, and each thread being pulled as tightly as possible.

The ends of the stitch are held up by an assistant, and the bobbin is inserted by laying its centre on the sutured posterior lip of the anastomosis, and drawing the ends of the gut over it with dissecting forceps. When it has been placed in position, it is held there by the finger and thumb of the surgeon or of his assistant. The second row of suture
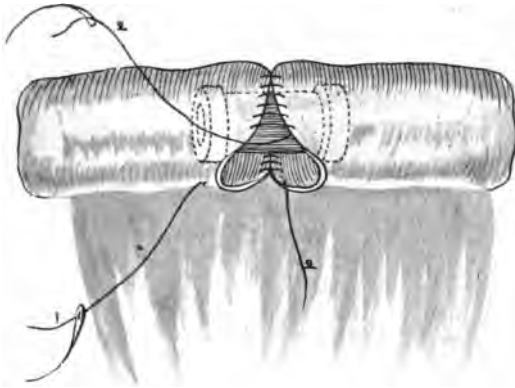
FIG. 70.—MAYO ROBSON'S BOBBIN IN POSITION. (AFTER MAYO ROBSON.)

1, The needle and thread of the preliminary continuous Lembert's suture ; 2, the suture which passes through all the coats.

—*i.e.*, that penetrating all the coats of the bowel—is then continued completely round the anastomosis to the point at which it had been commenced. It is then tied to the end left at the commencement of the stitch, and its knot tucked inside the mucous membrane. The bobbin will now be firmly fixed in position, and as there can be no further risk of any fæcal escape, the clamps should be removed. The needle used for the first suture—*i.e.*, that uniting the serous coats only—is taken up again,

and with it a continuous Lembert stitch is carried completely round the anastomosis covering, in the inner or penetrating suture. When the point of the commencement of this suture is reached, it is tied to the end which had previously been left long; the anastomosis is then complete. If a straight needle be used, it will be found easier to employ a continuous Cushing stitch rather than a Lembert.

This method, it will be seen, is not very easy, on account of the difficulty in inserting the first part of the continuous
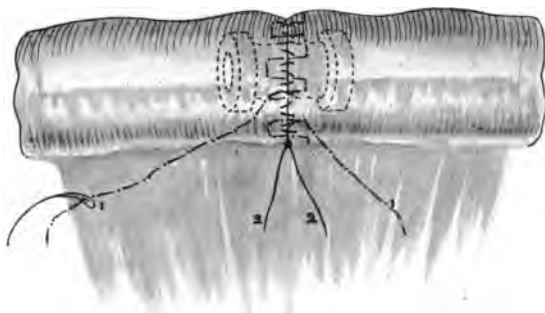
FIG. 71.—MAYO ROBSON'S BOBBIN IN POSITION, THE SUTURES
COMPLETED. (AFTER MAYO ROBSON.)

1, The continuous Lembert (dotted line); 2, the continuous suture passing through all the coats. The knot of suture 2 should be tucked inside the bowel.

Lembert suture, and you will see that the bobbin is of no assistance until the difficult mesenteric part of the anastomosis has been completed. In cases, however, where the mesentery is sufficiently long to enable one to bring the two cut ends of bowel outside the abdominal incision, the operation can be much simplified by leaving the whole of the peritoneal suture until after the bobbin has been fixed in position. The two pieces of intestine are held in apposition, and a continuous suture is made

to unite all the coats of the mesenteric half of each portion of intestine ; the bobbin is inserted and held in position while this suture is completed as described above. A continuous sero-muscular suture is then inserted all round the anastomosis, starting near the convex border, and paying particular attention to the inclusion of a sufficient amount of mesentery in the stitch.

Allingham's Bobbin.—Many surgeons use Allingham's bobbin in exactly the same way as has been described for the application of Mayo Robson's, and it acts equally well. The inventor himself advocated an easier and quicker method of employing it. A purse-string suture
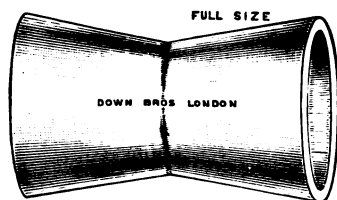
FIG. 72.—ALLINGHAM'S BONE BOBBIN. (DOWN BROS.)

of catgut is inserted round the end of each piece of gut in the same way as is done before the introduction of a Murphy's button (see Fig. 79). The bobbin is then introduced into the opening of one piece of gut, and the opening in the other piece of gut is drawn over the other end of the bobbin. The purse-string sutures are then tied tightly round each piece of gut, fixing them on to the bobbin, whose hourglass shape will prevent the gut from slipping off (see Fig. 73). The two portions of gut are now united by some interrupted serous sutures or by a continuous suture taking up the serous and muscular coats. It will be seen that this method is very easy to perform, but it is liable to be followed by considerable contraction, since not only has each end been constricted

by the purse-string sutures, but the continuous serous suture will be at some distance from the line of union, and so will cause a good deal of valvular projection within the lumen of the gut at this point. The method should only be used in a case where extreme haste is necessary.
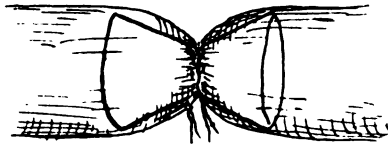
FIG. 73.—ALLINGHAM'S BONE BOBBIN IN POSITION. (ALLINGHAM.)

Landerer's Potato Bobbin consists of a piece of raw potato, which is cut into the shape shown in Fig. 74. It is used in precisely the same way as Allingham's bobbin. It will not be so readily absorbed as decalcified bone.
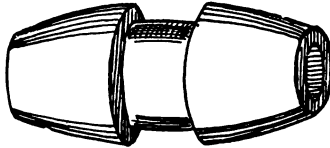
FIG. 74.—LANDERER'S POTATO BOBBIN. (GOULD AND WARREN.)

Carwardine's Forceps consist of two clamps, each $6\frac{1}{2}$ inches long, with very slender, bow-shaped blades, $\frac{3}{16}$ inch w de. They can be used with or without a rubber covering. To the handle of one clamp a thumb-screw is attached, and on the opposite handle of the other pair is a slot and depression corresponding to, and receiving the thumbscrew when the two forceps are united together.

They are used as follows : The twin pair of forceps are applied to the bowel above or below the part to be removed, and the gut is divided about $\frac{3}{4}$ inch from each

pair of forceps ; this will leave sufficient gut for suturing. The two forceps are then clamped together by the thumb-
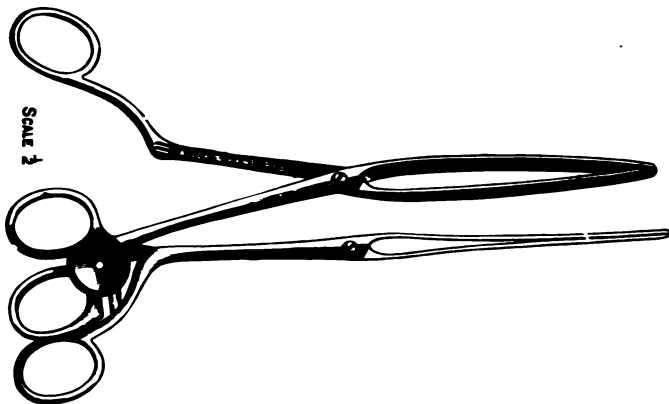
FIG. 75.—CARWARDINE'S FORCEPS. (ALLEN AND HANBURY.)
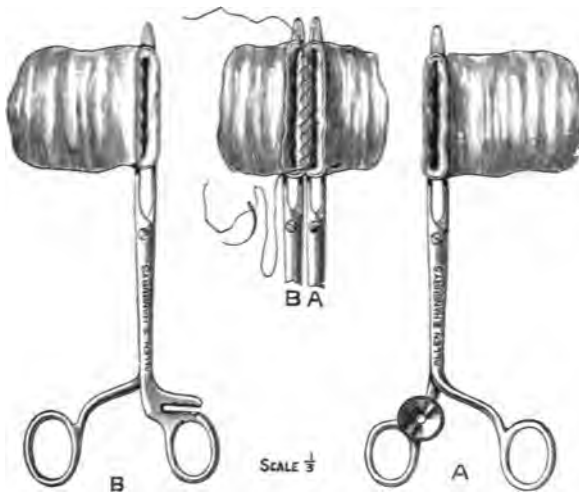
FIG. 76.—CARWARDINE'S FORCEPS, SHOWING THE METHOD OF EMPLOY-
ING THEM IN END-TO-END ANASTOMOSIS. (ALLEN AND HANBURY.)

screw, and will be parallel to each other. They can then be conveniently held in one hand. This is seen in Fig. 76. A posterior continuous peritoneal suture is first

inserted, and then a catgut stitch, passing through all the coats, is carried right round the circumference of the bowel, uniting the two cut ends. Finally, the anterior peritoneal surfaces are united with a continuation of the stitch used for the posterior peritoneal stitch.

The advantage of the method is that the two cut ends are held firmly in apposition during suturing, and that there is no diaphragm produced when union is complete, as is the case with O'Hara's forceps. It is open, however, to the objection that the forceps damage the vitality of the gut, and, as they are applied so close to the line of union, their use appears rather dangerous.

FIG. 77.—CARWARDINE'S FORCEPS : APPLICATION IN LATERAL ANASTOMOSIS. (ALLEN AND HANBURY.)

They can be used equally well for lateral anastomosis, and the method of applying them is shown in Fig. 77.

V. Anastomosis by Apparatus Alone

There is only one method which needs description in this class, and that is Murphy's button. This is of undoubted value where extreme rapidity of completing the operation is desirable, as when the patient is in a very grave condition. It, however, does not yield very satisfactory results, since the separation of the button takes place by sloughing of the opposed portions of intestine, and union may not be firm when the slough separates, and so extravasation may occur. Again, the button, after being separated, may cause fatal ulceration and perforation at some point below, or it may cause obstruc-

tion at the ileo-cæcal valve, and require a second opera-
tion for its removal. In the case of lateral anastomosis
it is open to the further objection that it causes an actual
obstruction till it separates.

The button is made in various sizes, but the two
principal ones are those for small and large intestine. It
is too well known to require any detailed description; the
accompanying diagram (Fig. 78) explains its mechanism.

The two halves are approximated by simply pushing
them together, but they can only be separated by un-
screwing. One half only has a spring, and this end is
the male portion, which is the heavier, and should be
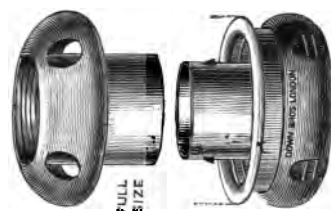
FIG. 78.—MURPHY'S BUTTON. (DOWN BROS.)

inserted in the lower segment of bowel. The projecting
ridge of the male portion is the spring plate, which keeps
the two pieces of gut in apposition, and the end of the
gut must not be tied round the groove below the plate,
but round the shank of the button.

It is applied in the following way:

A purse-string suture is inserted round the edge of
each piece of the gut. It is commenced opposite the
mesenteric attachment, and is continued by oversewing the
edge of the gut, as shown in Fig. 79. The stitch is always
passed from the serous to the mucous surface. When
arriving at the mesentery, it is important to pick up
both peritoneal surfaces of the mesentery in the running

stitch, so as to insure that they are brought within the
button.   This is done by passing the purse-string suture
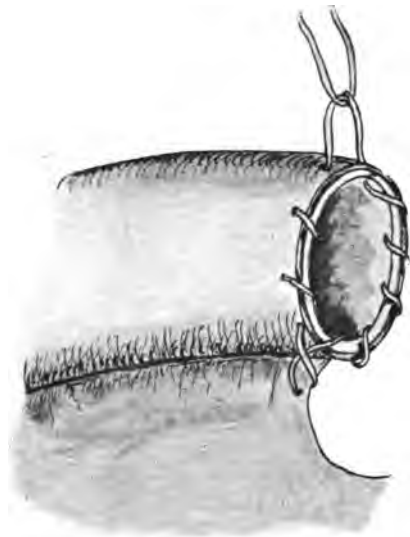
FIG. 79.—PURSE-STRING SUTURE.

along the edge of the gut from *right* to *left* as far as
the mesentery, then passing the suture through the
mesentery from *left* to *right*, and then continuing it along
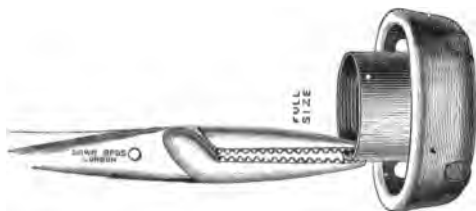
FIG. 80.—METHOD OF HOLDING ONE HALF OF BUTTON PRIOR TO
INTRODUCTION.   (DOWN BROS.)

the remainder of the edge of the gut from *right* to *left* ;
this forms a double loop at the mesentery.   When the

gut is completely encircled with the suture, the stitch must be passed from the mucous to the serous surfaces, so that both ends are on the serous surface. One half of the button is now held by a pair of artery forceps, and inserted sideways into the opening ; when the button is within the lumen of the gut, the running stitch is tightened and tied tightly round the shank of the· button. Any redundant mucous membrane is then snipped off, the end of the gut being deeply tucked within the groove of the button with a pair of dissecting forceps. The
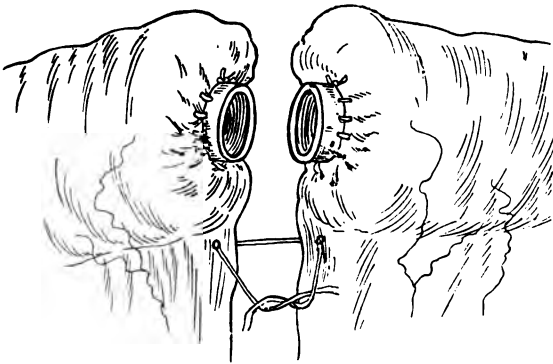
FIG. 81.—BOTH HALVES OF BUTTON IN POSITION, MESENTERIC STITCH PASSED. (AFTER GOULD AND WARREN.)

other half of the button is inserted into the other piece of gut in a similar way, and the running stitch is tightened. Before bringing the two halves of the button together it is well to insert a stitch in the edge of the mesentery at each end, which insures accurate contact at this point when the button is approximated ; this is shown in Fig. 81. The two halves of the button must be pushed together very gently, and it must be remembered that it is impossible to rectify any mistake in position when once the button has been closed up ; in the case of error, the only way is to cut it out of the intestine and

start afresh. The two halves do not require to be absolutely jammed together, since it is best that the actual contact of the intestinal walls should be maintained by the action of the spring. When the button is closed, the mesenteric stitch is tied, and one or two stitches uniting the mesentery complete the operation. Some surgeons have recommended a supporting row of Lembert's sutures, but Murphy himself was very adverse to this as being unnecessary, and, moreover, as acting as a hindrance to the passage onwards of the button, and likely to cause a valve-like obstruction at the line of union after the button was passed.

This is a method that everyone should be familiar with, and though its application seems very simple in a book, it requires some care and practice to insure that no mucous membrane overlaps the serous coat when the button is closed ; this, of course, would lead to failure of union and extravasation. The button separates by means of necrosis of the opposed pieces of gut, and it usually takes about ten days to pass down the intestinal canal. In some cases it has been retained for as long as forty days, and in most cases of gastro-enterostomy it remains permanently in the stomach. The indication for the employment of the button is the necessity for the rapid completion of an operation.

CHAPTER IV

SPECIAL OPERATIONS

On the Stomach

THE operations which are most often called for are : (1) Suture of a ruptured gastric ulcer or of a wound of the stomach ; (2) gastro-enterostomy ; (3) other operations
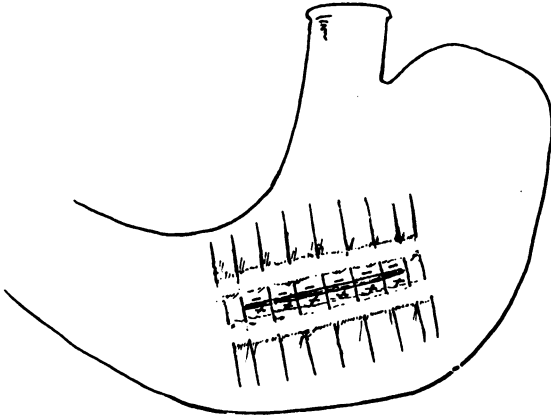
FIG. 82.—CLOSURE OF A RUPTURED GASTRIC ULCER BY DOUBLE ROW OF SUTURES.

The first are Halsted's sutures, which have been tied. A row of Lembert's have been passed outside these, but are not tied.

for relief of gastric ulcer; (4) pylorectomy; and (5) gastrostomy.

1. In the case of a rupture of a gastric ulcer it is seldom advisable to attempt to excise the ulcer, as the

surrounding walls of the stomach will be found to be infiltrated with inflammatory products, and so a very large area would have to be removed in order to get to healthy tissues. The best method of closing a ruptured gastric ulcer is by means of a double row of Lembert's or Halsted's sutures, and the first row of these must be placed at some little distance, about ½ inch, from the ulcer ; it necessarily follows that the row must be
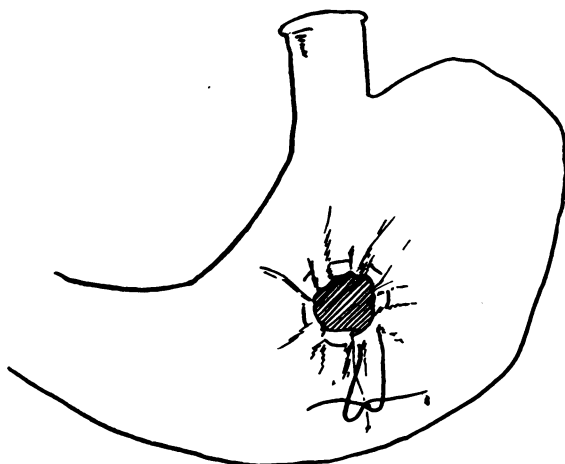
FIG. 83.—CLOSURE OF A RUPTURED GASTRIC ULCER, SECOND METHOD.

A purse-string suture passed round the ulcer at a distance from the perforation.

continued for about ¾ inch beyond the limit of the ulcer of each end ; this is shown in Fig. 82.

In some cases these Lembert's or Halsted's sutures will be found to cut out as soon as an attempt is made to tie them. In such cases a purse-string suture should be passed round the ulcer at a distance of about ½ inch outside it. The stitch must penetrate the muscular and submucous coats. The ulcer is invaginated when the

stitch is tied ; this is shown in Fig. 83. The suture may with advantage be reinforced by a row of Lembert's sutures over it, and by the application of a piece of omentum over the line of suture.

In the case of a clean-cut wound, or of a rupture of a healthy stomach, the opening should be closed by a double row of sutures, the first ones going through all the coats of the stomach with their knots inside, and the others taking up the serous and muscular coats only. Continuous sutures should not be employed, on account of the puckering of the stomach walls which would be caused.

2. **Gastro-Enterostomy.**—This operation is of great value, and when performed as an adjunct to suture of a gastric ulcer, it will aid the cicatrization of the sutured ulcer by preventing any distension of the stomach with flatus or food. The operation is most frequently performed in cases of intractable gastric ulcer and in old-standing chronic gastritis, in addition to cases of dilatation of the stomach due to organic obstruction at the pylorus. The organic obstruction may be due to cicatricial contraction after ulcer, to adhesions from without, or, lastly, to malignant disease.

There is a very great choice of methods of establishing a new opening out of the stomach. The operation of gastro-duodenostomy is not to be recommended, on account of the fixed position of the duodenum, although this difficulty has practically been overcome by Kocher, who frees the duodenum from its lateral attachment before uniting it to the stomach. It is now almost always the rule to attach the jejunum to the stomach. The first part of the jejunum can be readily found by turning up the great omentum and transverse colon, and feeling for a piece of the small gut just to the left of the first lumbar

vertebra, as shown in Fig. 84 ; this is hooked out of the wound with the finger, and pulled upon until no more gut comes, showing that the beginning of the jejunum has been found. The jejunum may be united either to the anterior or to the posterior surface of the stomach.

Anterior Gastro-Enterostomy. — In this operation, after finding the first part of the jejunum, the loop of gut is allowed to become slack, and a point about 6 to

FIG. 84.—FINDING THE FIRST PART OF THE JEJUNUM. (AFTER CHEYNE.)

The transverse colon has been turned upwards, and the jejunum found at the left border of the first lumbar vertebra.

9 inches from its commencement is selected for the anastomosis ; the loop of jejunum is made to pass up over the transverse colon, and is applied to the anterior surface of the stomach. In doing this the following points must be particularly attended to : (1) The loop must be applied to the stomach at a sufficient distance from its commencement, so that there will be no compression of the colon when it is stretched over it ; (2), the loop must be so applied that the peristaltic

waves in the stomach and in the jejunum shall be in the same direction ; and (3) it should be applied in a slanting direction from above downwards, so as to favour the passage of the stomach contents from the stomach through the anastomosis into the efferent rather than the afferent portion of the jejunum.
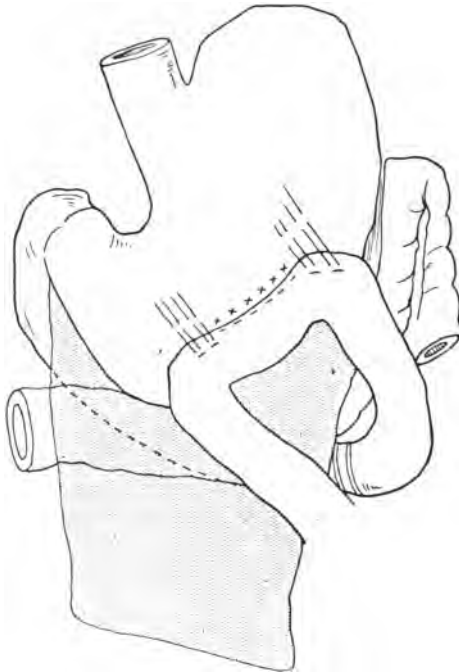
FIG. 85.—ANTERIOR GASTRO-JEJUNOSTOMY BY HALSTED'S METHOD.
The posterior row of sutures have been passed and tied. The corner stitches have been passed, but have not been tied.

Having paid attention to these points, the anastomosis may be done by Halsted's method in a precisely similar manner to that described for lateral intestinal anastomosis (*vide* p. 32). This is shown in Figs. 85, 86, and 87. Or it may be effected by a double continuous suture,

with guides, in the same way as described for lateral anastomosis. Halsted's method gave very good results in my hands, and for years I almost invariably employed it, but in some cases there has been subsequent contraction of the new opening, so of recent years I have always employed the double continuous sutures with guides.
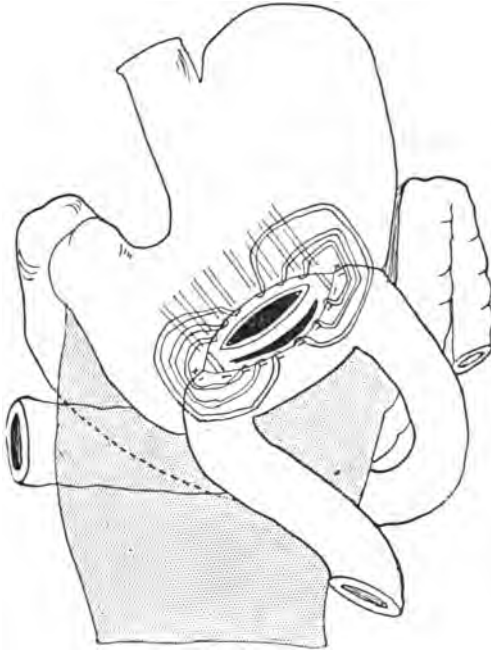
FIG. 86.—ANTERIOR GASTRO-ENTEROSTOMY BY HALSTED'S METHOD.
All the stitches have been passed, and those of the anterior row have been drawn aside to allow the openings to be made.

It only remains to speak of the use of bone bobbins and Murphy's button. I am inclined to consider these absolutely unsuitable for lateral anastomosis, since while the bone bobbin is *in situ* the opposite wall of the jejunum will completely occlude the opening in the bobbin or button, and the result will be that no food can pass out

of the stomach until the bobbin has become absorbed or has been passed. It will, therefore, usually be found that operations where these are employed are followed by sickness for the first few days. Murphy's button is open to the further objection that it has an irresistible
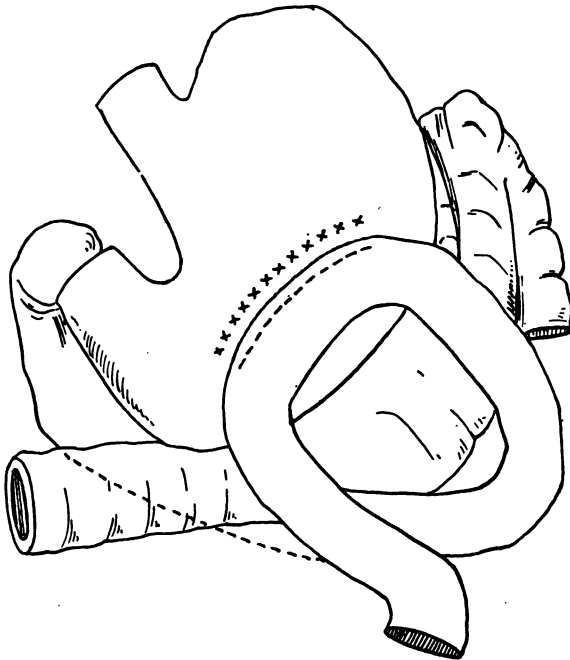
FIG. 87.—ANTERIOR GASTRO-ENTEROSTOMY BY HALSTED'S METHOD.
The operation completed.

tendency to pass backwards into the stomach instead of into the jejunum, and in such cases a second operation is necessary to remove the button.

Posterior Gastro-Enterostomy.—In the majority of cases it will be best to unite the jejunum to the posterior surface of the stomach; this can best be effected by turning up the transverse colon and tearing a hole in

the transverse mesocolon, so as to enter the lesser peritoneal cavity. In doing this care should be taken to reach the posterior surface of the stomach at a little distance from the pylorus, since the posterior wall of the lesser cavity is often adherent to the stomach close to the pylorus, and, moreover, in this part of the stomach the vessels within the mesocolon and on the lower border of the stomach are larger and more difficult to avoid.

Having thus exposed the posterior surface of the stomach, and identified the first part of the jejunum, we have to consider which portion of the jejunum should be used, and the direction in which it should be united to the stomach. In former days we used to select a point at some distance from the duodeno-jejunal fold, so as to insure the equal mobility of both parts entering into the anastomosis, and consequent absence of drag on the line of suture ; it was, however, found that the loop of jejunum left was liable to sag, and to lead to the formation of a vicious circle, and in several cases where this has occurred I have been obliged to do a second operation and effect an entero-anastomosis between the loops of jejunum on either side of the gastro-enterostomy. It is now universally agreed that the no-loop operation should be practised, and the jejunum should be united to the stomach at a point as close as possible to its commencement.

The next point to consider is the direction in which the jejunum is to be applied to the stomach. Formerly it was thought necessary to apply the jejunum to the posterior surface of the stomach in the direction from left to right, so as to secure iso-peristalsis ; it was, however, found that this method was sometimes followed by bilious vomiting, owing to the abrupt turn of the jejunum at the jejuno-duodenal fold causing a kink and

obstruction to the passage of bile past this point. The brothers Mayo were first to recognize this defect, and pointed out that the maintenance of iso-peristalsis was not of so much consequence as maintaining the natural direction of the jejunum from right to left; they therefore united the jejunum to the stomach in a direction from right to left, and have had no trouble from the absence of iso-peristalsis. The majority of English surgeons, however, adopt a middle course, and unite the jejunum to the stomach in a vertical direction—*i.e.*, transversely to the long axis of the stomach. This is the direction which I always adopt. This is shown in Fig. 88. The next point is to insure that the new opening should be at the lowest part of the stomach, and for this reason the lowest part of the opening is made to correspond to the greater curvature of the stomach. The jejunum is therefore applied to the posterior surface of the stomach, parallel to one of the transverse arteries, and two Lembert guides are inserted, uniting the two viscera; one is placed close to the greater curvature of the stomach, and the other 2 inches above this one. With the thread of one of these guides the posterior continuous serous stitch is inserted, and, when completed, is tied to the other guide. The openings are now made, and after the introduction of new through-and-through guides of catgut, a continuous suture through all the coats is inserted, and continued round the anastomosis, and tied with the knot inside. Finally, the serous stitch is continued over the anterior part of the anastomosis. It is now necessary to close the rent in the transverse mesocolon, since it is possible that small intestine may become herniated through it into the lesser cavity of the peritoneum, producing serious symptoms. In one case on which I operated for symptoms of obstruction, after a gastro-

enterostomy done by another surgeon, I found the whole of the small intestine in the lesser sac of the peritoneum.

There are two ways of closing the rent in the meso-colon. The edges of the rent may be united either to
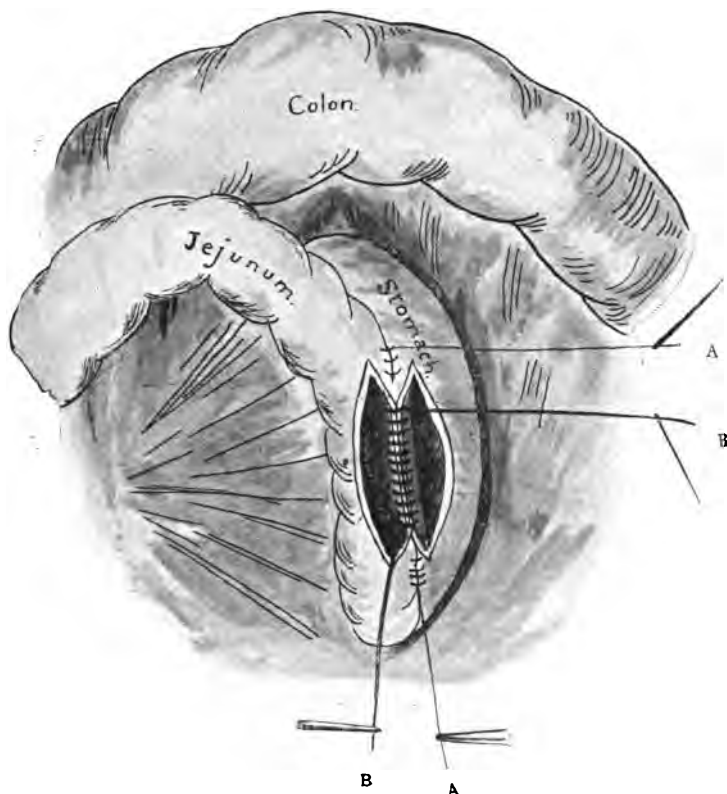
FIG. 88.—METHOD OF ATTACHING THE JEJUNUM IN POSTERIOR GASTRO-ENTEROSTOMY.

the stomach or to the jejunum. My practice has been to unite the edges of the rent by several interrupted sutures to the jejunum about $\frac{1}{2}$ inch from the line of suture. Besides preventing any hernia into the lesser sac of the

peritoneum, it insures that the anastomosis itself is in the lesser sac of the peritoneum, and so, should any peritoneal irritation occur at the line of suture, it would give rise to a localized collection of fluid, and not to general peritonitis.

In this operation care must be taken that no spiral twist should occur in the jejunum when the stomach is replaced within the abdomen, and some means should be adopted to insure that all the stomach contents pass through the new opening. If the pylorus is patent, it is found that after a time the food will pass through it, and not through the gastro-enterostomy, and therefore the ulcer will again become irritated by the passage of acid gastric juice over it. It should therefore be an invariable rule to occlude the pylorus in every operation of gastro-enterostomy, the only exception being cases where there is definite cicatricial stenosis of the pylorus. The simplest method of occluding the pylorus is by a series of rows of Lembert's stitches. Three stitches are passed in a row, the first $\frac{1}{4}$ inch below the pylorus, the second at the level of the pylorus, and the third in the stomach, $\frac{1}{4}$ inch above the pylorus. These three Lembert stitches are tied, and a second row are inserted $\frac{1}{4}$ inch on each side of the former line. These are tied, and a third row inserted. It will be found that these three rows of stitches produce a polypoid excrescence on the mucous surface of the pylorus, which completely blocks the opening.

One of the causes of failure after gastro-enterostomy has been the establishment of the so-called ' vicious circle.' This is due to the regurgitation of bile into the stomach, causing vomiting, or to the passage of food into the afferent loop of the jejunum, and consequent return of the food, mingled with bile, into the stomach. This gives rise to intractable vomiting and starvation. In

order to obviate this, we must prevent any kinking of the jejunum on either side of the anastomosis by attaching the jejunum to the stomach in a slanting direction, by uniting the jejunum to the stomach for ½ inch beyond the ends of the anastomosis, and by avoiding twists. One of the most common causes of vicious circle has already been alluded to — namely, the existence of a loop between the duodenum and the anastomosis. This,
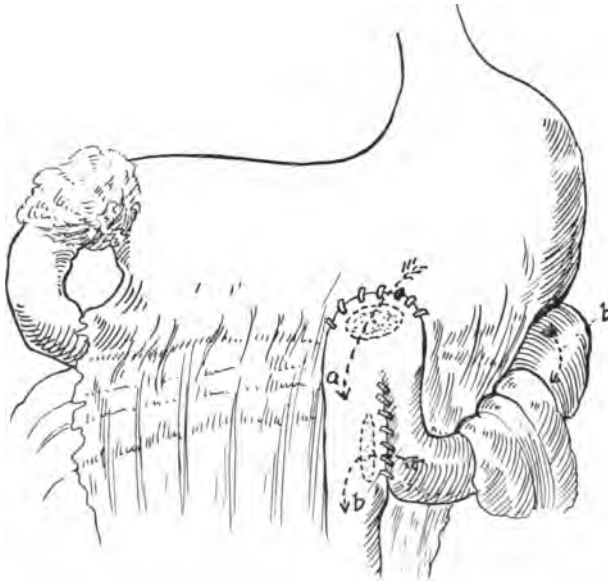
FIG. 89.—METHOD OF PERFORMING ENTERO-ANASTOMOSIS IN CASES OF ' VICIOUS CIRCLE.' (AFTER CHEYNE.)

of course, does not occur in modern operations, but, should ' vicious circle ' occur when a loop has been left in an anterior anastomosis, it will be necessary to perform a lateral anastomosis between the afferent and efferent loops on either side of the anastomosis, after which food and bile will pass onwards in the proper way instead of returning into the stomach. This is shown in Fig. 89,

which also represents a rather faulty gastro-enterostomy. The entero-anastomosis can be done by Halsted's method, by a double row of continuous sutures, or by Murphy's button, when time is of consequence.

In order to prevent the possibility of the establishment of a vicious circle, various operations have been devised, but I will only refer to one which has been invented by
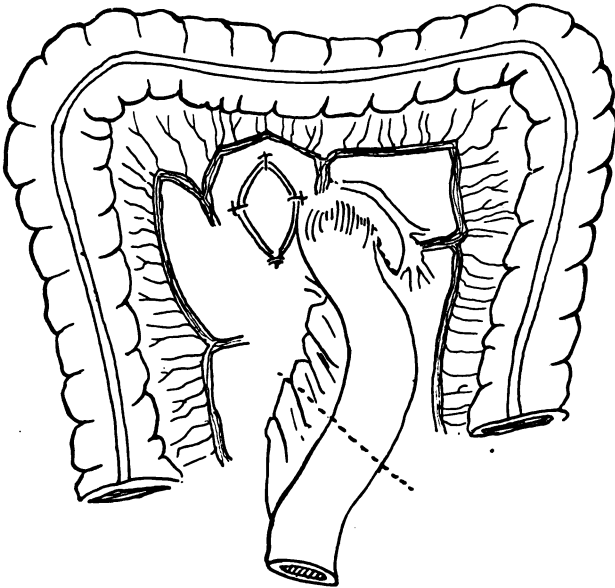
FIG. 90.—GASTRO-ENTEROSTOMY BY ROUX'S METHOD.

The dotted line shows the point at which the jejunum is divided. The hole has been torn in the mesocolon.

Roux, of Lausanne. This, however, is a more severe operation than a simple gastro-enterostomy, and will take a longer time to perform. The posterior surface of the stomach is exposed by dividing both layers of the meso-colon; the jejunum is then completely divided about 4 or 5 inches from the ligament of Treitz. The distal end of the jejunum is then implanted into the posterior

surface of the stomach by a double continuous suture, and the cut end of the proximal portion of the jejunum is implanted into the convex border of the distal portion about 2 or 3 inches below the gastro-enterostomy. This is shown in Fig. 91. The jejunum must be implanted into the stomach close to the greater curvature.

It will readily be understood that no vicious circle is
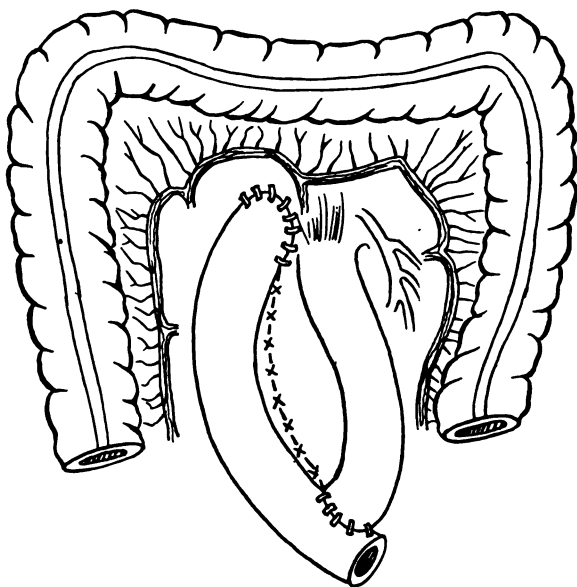
FIG. 91.—GASTRO-ENTEROSTOMY BY ROUX'S METHOD.
The operation completed.

possible. The principal danger beyond shock will be the subsequent contraction of the opening between the stomach and jejunum. In order to prevent this, I have modified the operation by occluding the cut end of the distal part of the jejunum, and uniting the gut to the stomach by a lateral anastomosis. In this way a much larger opening is secured, and the risk of contraction of the opening is removed.

Comparison between the Different Methods of Performing Gastro-Enterostomy

Disregarding for the moment Roux's operation as being much more severe, and only indicated in cases in which symptoms have recurred after other methods, we will consider the main points in favour of the anterior and posterior operations.

The points in favour of the anterior operation are :

1. The greater ease in its performance, and consequently increased rapidity in operating.

2. The certainty of uniting the jejunum to the stomach in such a direction as to secure iso-peristalsis.

3. In the erect position the anastomotic opening will be at the lowest point of the stomach, since the weight of the attached small intestine will pull the anterior surface of the stomach downwards.

4. The avoidance of any injury to the transverse meso-colon, and the absence of any risk of hernia through the opening in it.

The disadvantages of the operation are :

1. The danger of compression of the transverse colon by the jejunum when the anastomosis has been made too close to the duodenum.

2. When the patient is in the horizontal position, the position of the opening will favour the passage of bile into the stomach, and will hinder the passage of stomach contents into the jejunum.

3. As the jejunum is so much displaced out of its ordinary position, there is a great danger of a kink on either side of the anastomosis.

4. Distension of the transverse colon may press upon the jejunum and produce obstruction to the passage of bile through it.

5. There is a risk of the necessary loop of jejunum sagging, and so causing a vicious circle. The risk makes it necessary to effect an entero-anastomosis in every case at the same time as the gastro-enterostomy.

On the other hand, the advantages of the posterior operation are :

1. The ready passage of stomach contents through the new opening when the patient is in bed.

2. The absence of any danger of constriction of the transverse colon by the loop of jejunum.

3. The absence of risk of a kink in the jejunum beyond the anastomosis, if it be united in a proper direction.

4. The avoidance of the necessity of doing an entero-anastomosis at the same time.

The disadvantages are :

1. The greater difficulty in its performance, the necessary exposure of the transverse colon during the operation, and the increased shock.

2. The greater difficulty in attaching the jejunum in a proper direction to the stomach.

3. When the jejunum is attached to the middle of the posterior surface of the stomach, and the point of union is fixed to the hole in the transverse colon, the anastomosis cannot change its position when the patient stands up, and in the erect position the new opening may no longer be at the most dependent part of the stomach.

4. The risk of hernia through the opening in the transverse mesocolon.

It will be seen that there is a great deal to be said for and against each procedure, and that neither is vastly superior to the other. Personally, I should recommend the anterior operation to a surgeon who had not done many cases, and leave the posterior operation to those who have had a large experience. For many years I did

the anterior operation almost exclusively, but experience has shown that the posterior gives the least trouble, and so I now do it in every case, except where the posterior surface of the stomach is not freely movable. In a case of large gastric ulcer on the posterior surface of the stomach, which has caused adhesions between the stomach and the pancreas, and in cases of malignant disease of the posterior wall of the stomach, which has fixed the organ to neighbouring parts, the anterior operation should be performed, but I now make it an invariable rule to do an entero-anastomosis between the jejunum above and below the anastomosis at the same time. In one or two cases where there has been a return of symptoms after the posterior operation, I have performed an anterior gastro-enterostomy, combined with entero-anastomosis, with complete success.

I am inclined to think Roux's operation unnecessarily severe as a routine measure, and I have only performed it in cases in which there has been recurrence of trouble after a posterior gastro-enterostomy.

The other operations on the stomach for gastric ulcer, to which I refer, are (1) pyloroplasty, and (2) Finney's operation.

1. **Pyloroplasty.**—This operation was recommended by Heinke and Mickulicz for the relief of pyloric stricture, and as a substitute for gastro-enterostomy.

It consists in the division of the stricture in a horizontal direction, and the suture of the resulting incision in a vertical direction.

It is performed as follows :

An incision is made through the entire length of the strictured pylorus, and is continued into the healthy stomach and duodenum for at least $\frac{1}{2}$ inch on each side. It is easiest to make the incision into the stomach first,

close to the pylorus, and then to pass a director through the stricture, and divide the pylorus horizontally with scissors ; the incision is then continued into the duodenum for $\frac{1}{2}$ inch. Two hooks are then inserted into the middle of the incision, and the edges of the incision are pulled apart so as to make a lozenge-shaped opening. A stitch uniting the whole thickness of the stomach is then inserted at the angles of the original incision, and these
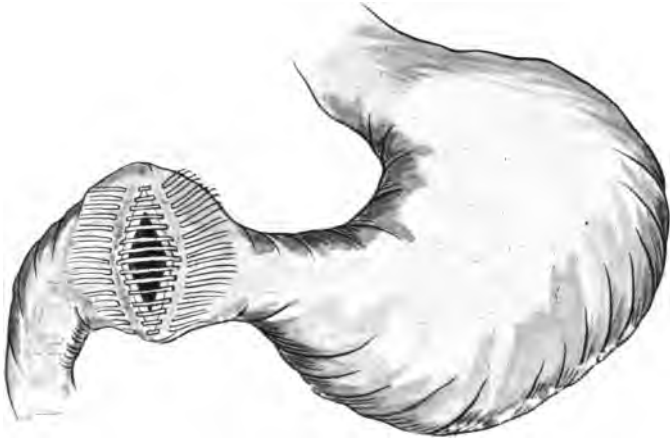
FIG. 92.—PYLOROPLASTY. (AFTER GOULD AND WARREN.)
A row of Lembert's sutures have been passed, and have converted the horizontal incision into a vertical one.

are drawn together so as to convert the horizontal into a vertical cicatrix. This is shown in Fig. 92.

Several other points of interrupted sutures going through all the coats of the stomach and duodenum are then inserted so as to completely close the opening. Over this row of sutures a row of Halsted's sutures is introduced in the ordinary way.

This operation is only applicable to fibrous strictures of the pylorus, and should never be done either in malig-

nant disease or in any case where active ulceration is present. It is open to the objection that, although the actual pyloric opening is enlarged by the manœuvre, it is apt to produce a kink at the pylorus, and the opening is very liable to contract. A most important objection to its use lies in the fact that in a dilated stomach the pylorus is no longer the lowest point in the stomach, and so even if the pylorus be made patent the dilated stomach will not be able to empty itself, and the patient will suffer from the effects of decomposition of retained stomach contents. In several cases in which I have employed this method I have found it necessary to perform a gastro-enterostomy on a subsequent occasion. The risk of the operation in non-malignant cases is very slight.

2. **Finney's Operation.**—This operation is a combination of pyloroplasty and gastro-duodenostomy. Finney avoids the disadvantages of gastro-duodenostomy by making a preliminary free separation of the peritoneum on the outer side of the duodenum, as recommended by Kocher, which enables the duodenum to be applied to the anterior surface of the stomach without any dragging. It is important that this freeing of the duodenum, and also of the pylorus, should be very thoroughly performed. Two guides are then inserted, the one through the upper wall of the pylorus, the second uniting the anterior wall of the duodenum to the anterior wall of the stomach about 4 inches below the first guide. The central portion of this second guide is pulled out, and clamped, as in the operation for end-to-end anastomosis. On pulling on the guides, a definite ridge is formed, and the duodenum and stomach can be united by a posterior serous suture, either interrupted or continuous. This is seen in Fig. 93. According to Finney's directions, the operation should be proceeded with in a similar manner to Halsted's operation

for gastro-enterostomy—that is to say, the opening in
the bowel is not to be made until the anterior row of
sutures has been inserted. When the row has been
inserted, the sutures are pulled aside with retractors
(as shown in Fig. 86), and the incision made. The
stitches employed are Halsted's, and they are commenced
⅛ inch from the lower end of the continuous serous suture.

FIG. 93.—FINNEY'S OPERATION : PASSAGE OF CONTINUOUS LEMBERT
STITCH.

A horse-shoe incision is commenced ½ inch from the lower
end of the continuous serous suture in the stomach, and
is carried through the stomach up to the pylorus, through
the pylorus, and down the duodenum to within ½ inch
of the lower end of the continuous serous suture. This
is shown in Fig. 94. The coats of the stomach and of
the duodenum are next united with a continuous catgut

suture, and, finally, the mattress sutures are pulled tight and tied.

The size of the opening can be increased to any extent, and it is situated practically at the lowest part of the stomach, therefore there is not the same objection to this operation as there is to pyloroplasty. It is,
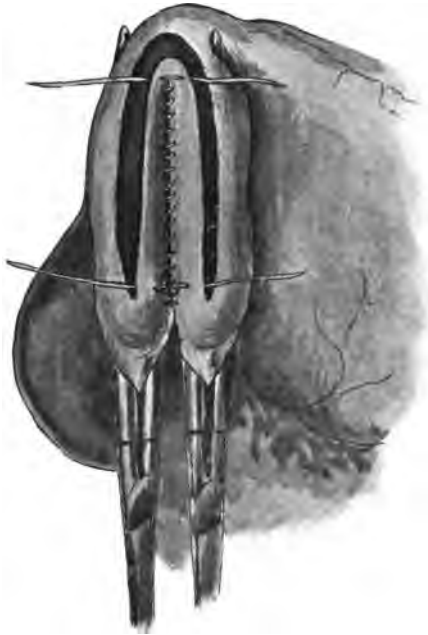
FIG. 94.—FINNEY'S OPERATION : INCISION INTO THE DUODENUM AND THE STOMACH.

however, more difficult to perform than gastro-enterostomy, and it does not yield any superior results.

Pylorectomy and Partial Gastrectomy.—These are very severe operations, and should be almost exclusively reserved for cases of malignant disease. Unfortunately, only a very few cases of cancer of the pylorus are capable of removal, since, by the time that a tumour can be felt

through the abdominal wall, it is probably of such a size and is accompanied by such extensive secondary infection that removal is impossible.

When, however, a growth is freely movable, and the enlargement of the glands does not extend too deeply, removal is certainly indicated, since, even if recurrence occur, life will be prolonged for a longer time than after simple gastro-enterostomy. The operation presents two chief difficulties : (1) The cut ends of the stomach and of the duodenum are of such different sizes that union between the two is very difficult, and there is always a considerable risk of extravasation at the point where the suturing of the stomach, necessary to reduce the size of its cut end to that of the duodenum, joins the actual anastomosis. Moreover, if any amount of duodenum be removed with the growth, the remaining portion will be only partially surrounded by peritoneum. (2) Another difficulty lies in the fact that the duodenum is a fixed organ and the stomach a movable one, so they are not suitable for uniting together. To obviate the difficulty of uniting the small orifice of the duodenum to the large opening of the stomach, Kocher has recommended that the opening in the stomach should be completely closed with a double row of sutures, and that the end of the duodenum should then be implanted into the posterior surface of the stomach about 1 inch from the cut end. This, however, is open to the objection of uniting a fixed to a movable viscus. A much more satisfactory method consists in completely closing the ends of the duodenum and of the stomach, and then doing a gastro-jejunostomy ; this is shown in Fig. 95.

In dealing with a growth of the stomach, it is most important to remove completely all enlarged glands. The situation of these glands is along the greater and lesser

curvatures of the stomach, and they will be found to extend along the greater curvature for a long distance beyond the growth. In order to remove the glands, it is therefore necessary to remove practically the whole of the greater curvature of the stomach.

It is best to first divide the lesser omentum close up to the under surface of the liver, doing this between artery forceps, and then to ligature the coronary and pyloric
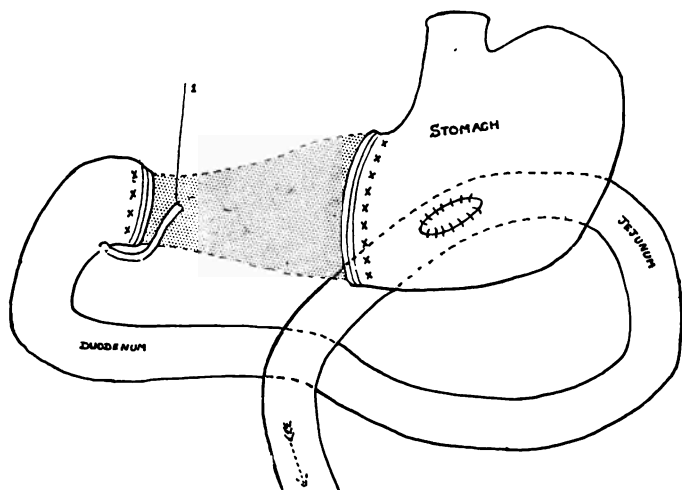
FIG. 95.—PYLORECTOMY COMBINED WITH GASTRO-ENTEROSTOMY.

1, Termination of common bile-duct.

arteries. The gastro-colic omentum is next divided close to the transverse colon ; the pyloric portion of the stomach will then be free. Two clamps are then applied to the duodenum at least 1 inch below the growth, and the duodenum divided between them. The open end of the duodenum is then closed with a catgut purse-string suture, and the stump invaginated with Lembert's sutures in the way described for occlusion of intestine (see Fig. 29). The pylorus and stomach are then turned to the left, and

the division of both the gastro-hepatic and the gastro-colic omentum completed. In most cases there will be some adhesions to the anterior surface of the pancreas, and great care must be taken not to injure this organ, as the bleeding may be very troublesome. It is best to perform the gastro-enterostomy before removing the stomach, as traction on the stomach enables one to unite the jejunum to the cardiac portion of the stomach more easily. A hole has to be torn in the transverse meso-colon, as in ordinary gastro-enterostomy, and the loop of jejunum brought through this. It is then united to the lowest part of the cardiac portion of the stomach at least 1 inch from the point at which the stomach is to be divided. When the anastomosis has been com-pleted, clamps are applied to the stomach 1 inch from the gastro-enterostomy, and the stomach divided between the clamps; any bleeding parts are tied, and the cut edges of the cardia are now united with a continuous catgut stitch, which will stop any oozing. Over this, a continuous Lembert or series of Halsted's stitches are passed. The hole in the mesocolon is stitched to the jejunum below the gastro-enterostomy, and the operation is complete.

In some cases of suspected cancer of the pylorus, I have varied the order of procedure. After performing an exploratory operation, and after examining the growth and its connections, I have united the jejunum to the stomach at some considerable distance from the pyloric growth. When the patient has recovered from this operation, the question of pylorectomy is discussed, and is urged, if the growth is freely movable. A fortnight after the first operation the abdomen is reopened, and the pyloric tumour, together with the glands, are removed, and the ends of the stomach and duodenum closed with a double row of sutures. This method of operating in

two stages has some advantages, especially in debilitated subjects. It enables the patient to regain strength by taking food before submitting to the shock of the pylorectomy ; and the shock is less, as the duration of each operation is not considerable ; and as there is not so much need for hurry, the second operation is likely to be more thorough.

In the cases in which I have operated by this method the results have been satisfactory ; all recovered from the operations, and lived for from one to three years after them.

Gastrostomy.—The last operation to be described is gastrostomy. The main difficulty about the operation is to prevent the escape of acid gastric juice from the opening in the stomach ; this causes intense irritation of the skin for a considerable distance round the opening. Several methods have been devised to prevent the regurgitation, but none are completely successful in this respect. The simplest method is a modification of the one described by Frank. An incision about 3 inches long, with its lower limit at the umbilicus, is made about the centre of the left rectus muscle. After the skin and superficial fascia have been divided, the anterior rectus sheath is opened, the tendinous intersection, which presents in the wound, is divided with a scalpel, and the fibres of the rectus muscle are separated with a blunt instrument. The posterior rectus sheath is exposed, and this is divided, together with the peritoneum. The anterior wall of the stomach will then be exposed, if the organ is not too much contracted by starvation. A piece of the anterior wall of the stomach is picked up, and brought out of the wound, producing a conical pouch ; the apex of this is caught with rat-tooth clip forceps. A continuous silk or thread suture is now passed between

the parietal peritoneum and the base of the cone of protruded stomach, closing the peritoneal cavity, and leaving the cone of stomach outside. This is shown in Fig. 96. A second small transverse skin incision, 1 inch long, is made about 1 inch above and outside the first incision. Only skin fascia and anterior rectus sheath
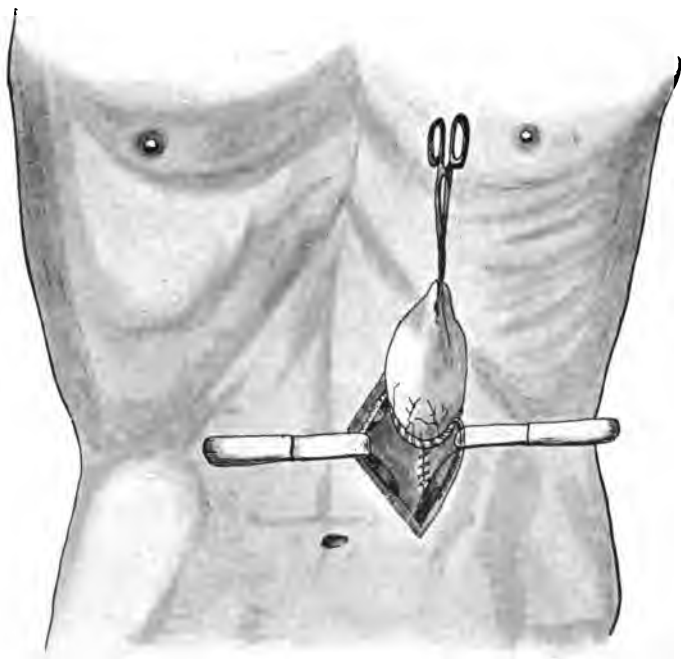
FIG. 96.—FRANK'S OPERATION FOR GASTROSTOMY.
Pouch of stomach-wall sewn to the parietal peritoneum.

are divided; a pair of clamp forceps are pushed from this incision into the original wound, and the apex of the cone of stomach is picked up with these forceps, and dragged through the upper transverse opening, through which about ½ inch should protrude. This is fixed to the margin of the opening by silkworm-gut stitches passing

between the skin and the serous muscular and submucous coats of the stomach. This is shown in Fig. 97. The original incision in the abdominal wall is then united together in layers as much as possible, the anterior rectus sheath and the skin being completely closed. The apex of
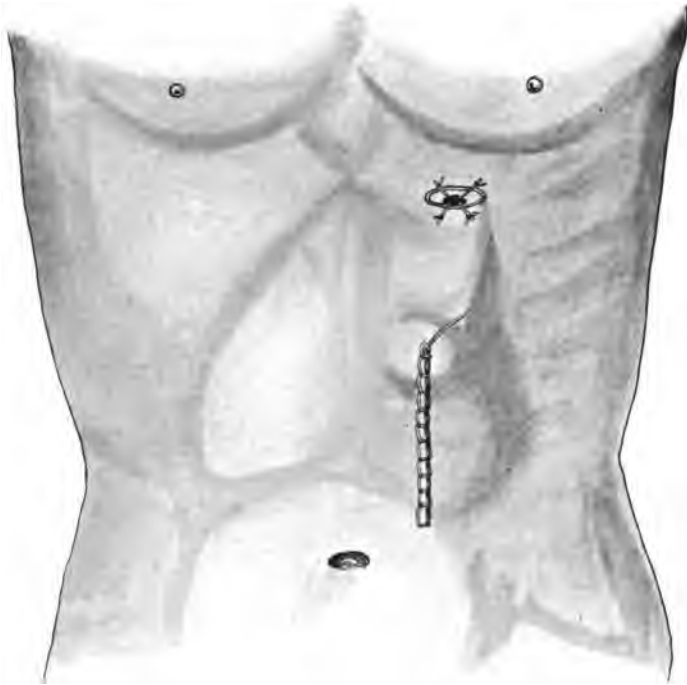
FIG. 97.—FRANK'S OPERATION FOR GASTROSTOMY.
Abdominal incision closed, and apex of cone of stomach united to skin.

the pouch of the stomach is opened after forty-eight hours, and a catheter introduced into the stomach for the purpose of feeding. This should be left in for two or three days, and then only introduced when it is required to feed the patient. This method, by producing a rather valvular opening into the stomach, obviates to a consider-

able extent the tendency to regurgitation of gastric juice.

Jejunostomy.—Owing to the considerable difficulty often experienced in dragging a piece of contracted stomach into the wound, and to the risk of regurgitation of gastric juice through the new opening, I am rather in favour of abandoning the operation of gastrostomy, and substituting that of jejunostomy in its place. If a simple opening be made in the jejunum, great trouble will be experienced from the escape of jejunal contents from the opening. If, however, an entero-anastomosis be made between the pieces of gut on either side of the new opening, this difficulty will be got over. The absence of gastric digestion after a jejunostomy is of no importance, since the food can be peptonized before it is given, and, moreover, it will be acted upon by the pancreatic ferments. The operation can be performed in two ways : the first is by completely dividing the jejunum about 2 inches from its commencement, the distal end being attached to the skin, and the proximal end being implanted into the distal. A simpler way, however, consists in the performance of a lateral anastomosis, and the attachment of the loop of jejunum to the skin. The operation is performed as follows : An incision is made similar to that employed for gastrostomy. The great omentum is pushed to the right, and the jejunum felt for at the left side of the first lumbar vertebra. The loop is brought out of the wound, and a lateral anastomosis is now made between the jejunum, 1 inch below its commencement, and a piece of gut about 8 or 9 inches lower down. This can be done by continuous or interrupted sutures. The centre of the short-circuited loop is then stitched to the abdominal wall. A continuous Lembert is used to unite the parietal peritoneum to the serous, muscular, and submucous coats of

the loop about 1 inch from its apex. The rest of the abdominal wound is then closed, the layers being sutured separately. The apex of the loop is then sutured to the skin by interrupted silkworm-gut sutures, and the upper part of the incision is closed.
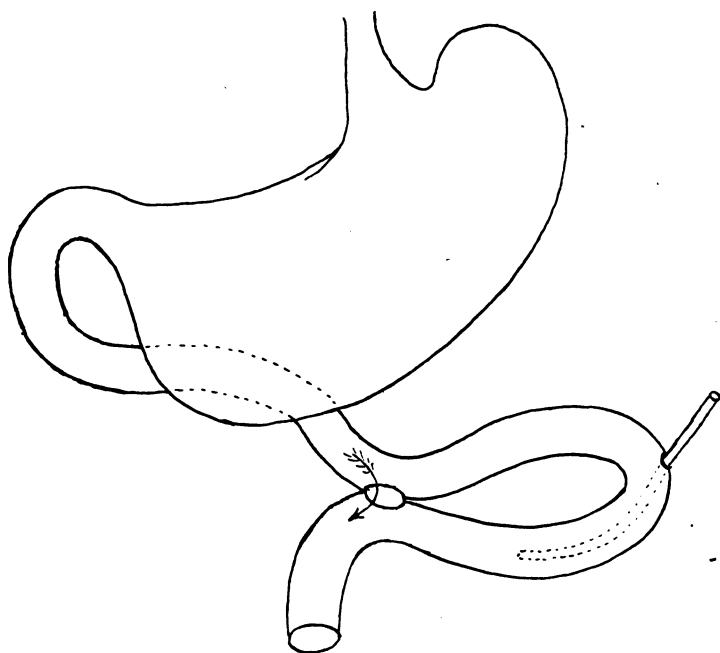
FIG. 98.—JEJUNOSTOMY COMBINED WITH ENTERO-ANASTOMOSIS.

The jejunum is opened, and a rubber catheter is inserted into the loop and fixed in the opening by a catgut purse-string suture. The first feed is at the time of the operation. The operation is shown in Fig. 98.

CHAPTER V

SPECIAL OPERATIONS (*continued*)

Operations on the Large and Small Intestines

1. **Ileo-Colostomy.**—The ileum may be united either to the movable caput cæci, to the transverse colon, or to the sigmoid. The operation is required in cancer of the cæcum or colon, which does not admit of removal; in the case of an artificial anus of the small intestine or colon ; in cases of volvulus of the sigmoid ; in some cases of ulcerative colitis; and as part of the operation of colectomy.

In this operation care must be taken to select a loop of the ileum close to the cæcum ; this is found by passing the finger down to the cæcum, and picking up the coil of small intestine nearest to the cæcum. This should then be brought out of the wound, and the end nearer to the cæcum should be pulled upon till no more gut comes out, when it will be known that the last part of the ileum has been reached. The lower portion of the ileum can also be recognized by the absence of valvulæ conniventes in this portion. Identification of these, which can be felt and seen through the intestinal wall, will obviate the risk of attaching the jejunum to the sigmoid. Having found out the lower part of the ileum, the coil is slackened so as to select a part about 6 or 7 inches from the cæcum ; this distance is necessary so as to avoid any dragging on the anastomosis. Care must

also be taken to unite the ileum to the colon or sigmoid in such a way that the waves of peristaltic contraction shall travel in the same direction on either side of the anastomosis.

The anastomosis may be performed either by lateral anastomosis or by implantation ; in the former case
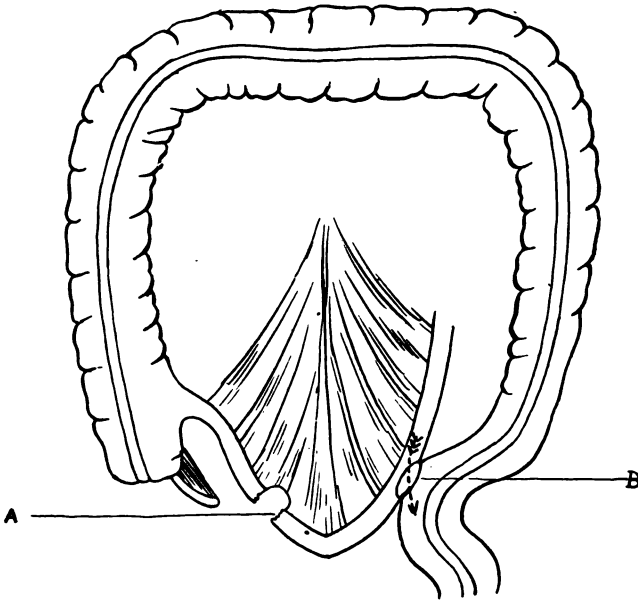
FIG. 99.—THE OPERATION OF ILEO-SIGMOIDOSTOMY.

A, Occlusion of ileum between the anastomosis and the cæcum ; B, the anastomotic opening between the ileum and sigmoid.

either Halsted's method (*vide* p. 32) or the double continuous suture (*vide* p. 39) can be employed. I have used Halsted's method in many cases, and it has certain advantages, especially when dealing with a distended ileum, since the sutures are all passed before the gut is opened, and soiling of the wound is unlikely to occur. The double continuous suture with guides, however,

makes a firmer joint, and can be done more rapidly. Bobbins and buttons are unsuitable in this operation, for the reason pointed out before—namely, that the opposite walls of the small intestine stretched over the bobbin prevent the passage of fæces through the anastomosis so long as it remains *in situ*. When a lateral anastomosis is performed for the cure of an artificial anus, or as part of an operation for the removal of a tumour of the colon, the small intestine on the distal side of the anastomosis will have to be divided and occluded as described on p. 31. When, however, the operation is performed for obstruction due to irremovable cancer, no occlusion operation will be necessary. In the operation of implantation the ileum is divided at a few inches from the ileo-cæcal valve, and an opening (of a length corresponding to the diameter of the ileum) is made in the anterior surface of the colon or sigmoid. The proximal end of the ileum is then united to this opening by a double row of continuous sutures. The distal end of the ileum is then closed as described before. The disadvantages of implantation are (1) that it is difficult to prevent leakage at the mesenteric border of the ileum, and (2) that the opening is liable to contract, but this latter disadvantage can be minimized by enlarging the cut end of the ileum by an incision in its convex border before implanting it.

The operation of ileo-colostomy is a very satisfactory one, and the mortality is small ; it is strange that patients do not suffer any ill-effects from having nearly the whole of their large intestine cut off. After a few weeks the motions become quite formed, and there is no increased frequency in passage of them.

2. **The Introduction of Paul's Tubes.**—Paul's tubes are made of glass, and of two sizes—one for the small

and the other for the large intestine. Their shape is shown in Fig. 100 ; the groove at the lower edge is for the retaining suture to lie in, and prevents the tube from slipping into, or out of, the bowel.

The Operation of Enterostomy

It is very rarely necessary or desirable to make an artificial anus in the small intestine, since the distress occasioned by the continual passage of liquid fæces over the wound is almost intolerable. The operation may, however, sometimes be necessary as a temporary measure

FIG. 100.—PAUL'S TUBES. (DOWN BROS.)
1, For large intestine ; 2, for small intestine.

in cases of acute obstruction, when the patient is so collapsed that any search for the cause of the obstruction is out of the question. As a permanent measure it is occasionally called for in cases of extensive malignant disease of the pelvic organs, where no anastomotic operation is possible. It is performed in the following way : A loop of distended intestine from the right iliac fossa is brought out of the abdominal wound, and is compressed on each side by the fingers of an assistant or by clamps. A lateral purse-string suture is then passed through all coats of the bowel round the place where it is proposed to make an opening. The opening is then made just

8

the same length as the diameter of a small Paul's tube, which is immediately slipped in, and the purse-string suture tightened. Care must be taken to sponge away any intestinal contents which may escape. A rubber tube fixed to the end of the Paul's tube will convey the intestinal contents away from the wound, and prevent any further soiling of it. The loop of intestine is then fixed to the abdominal wall. It should not be fixed to the skin, as shown in Fig. 101, since this will produce a kink in the gut, and will interfere with the re-establish-

FIG. 101.—METHOD OF INTRODUCTION OF A PAUL'S TUBE IN
ENTEROSTOMY. (AFTER CHEYNE.)

The right-hand figure shows the purse-string suture inserted before the
bowel is opened ; the left-hand figure shows the tube tied in, and
the loop of intestine fixed to the skin by means of two safety-pins.

ment of the normal channel when the obstruction is relieved and it is wished to close the artificial anus. It is best, therefore, to fix the gut to the parietal peritoneum only, after which the loop is allowed to fall back into the abdomen, and no spur will remain.

In fixing the gut to the parietal peritoneum, it is necessary to avoid any constriction of the new opening, and therefore a purse-string suture is unsuitable. The gut may be fixed by four sutures passed as follows : The first stitch is passed above the tube through the two edges of the parietal peritoneum and is made to pick

up the serous, muscular, and submucous coats of the intestine. A similar stitch is passed 1 inch from this below the tube. A lateral stitch is passed on each side, picking up the edge of the parietal peritoneum, then the serous, muscular and submucous coats of the bowel, and then the parietal peritoneum of the same edge. This will securely fix the gut, and will not interfere with the patency of the opening. This method of fixation is also employed in attaching the gall-bladder to the abdominal wall in cases of cholecystotomy. The two ends of the abdominal wound should be closed with sutures, but the central part should be left open, and gauze-packing placed round the Paul's tube.

The Paul's tube will probably remain *in situ* for about four days, when it will separate. By this time, however, the peritoneal adhesions are quite firm, and there is no risk of extravasation. The rest of the abdominal wound, too, is covered with granulations, so it will not be much irritated by the passage of fæces over it.

The Operation of Colotomy

This operation has now become quite a rare one. It should, I think, be restricted to those cases of rectal obstruction which are incapable of removal; to cases of carcinoma at the lower end of the sigmoid, where it is impossible either to remove the growth or to anastomose the ileum to the sigmoid below the growth; to cases of recto-vesical fistula; to cases of intractable rectal stricture; and to cases of inoperable malignant disease of the pelvic viscera.

It is sometimes performed as a temporary measure preliminary to or in the course of removal of a carcinoma of the colon, sigmoid, or rectum.

No mention need be made of the lumbar operation,

since it has practically fallen into disuse. The main points in the inguinal operation are (1) to prevent infection of the abdominal wall; (2) to form a proper spur, so that the intestinal contents cannot go on past the opening; and (3) to endeavour to obtain some control over the artificial anus. The first point is effected by deferring the opening of the bowel for a few days after attaching it to the skin, and by conducting the fæces away from the wound by means of a Paul's tube; the second is brought about in a variety of ways—either the edges of the skin are brought together within a hole in the mesosigmoid, or a stitch is passed through the mesosigmoid and attached to the abdominal wall, or a glass rod or piece of gauze is passed through a hole in the mesosigmoid, etc.; and the third is rendered possible by splitting the fibres of the rectus muscle, instead of dividing them when opening the abdomen.

I will describe the method which I have devised, and which I have now employed for some years. It absolutely insures that no fæces can pass into the lower part of the sigmoid, since the gut is completely divided, and there is a bridge of skin between the two openings. The operation is performed as follows :

The incision in the abdominal wall is made about ¾ inch from the outer edge of the left rectus muscle; it should extend downwards from opposite the umbilicus for 3 inches. The anterior rectus sheath is divided, and the fibres of the rectus muscle are separated. The posterior rectus sheath is then divided, and the peritoneum opened. In old descriptions of inguinal colotomy it is directed that the peritoneum should be stitched to the skin all round the wound before fixing the bowel; this was with the idea of preventing infection of the muscular planes of the abdominal wall. The risk of suppuration in the

muscular planes of the abdominal wall is not great with antiseptic precautions, and it is found that much firmer adhesions will take place between the sigmoid and the tissues of the abdominal wall than between the sigmoid and the parietal peritoneum alone. The peritoneum, therefore, should not be stitched to the skin, but after opening the peritoneal cavity, the loop of sigmoid is brought out of the wound, and a hole is torn in
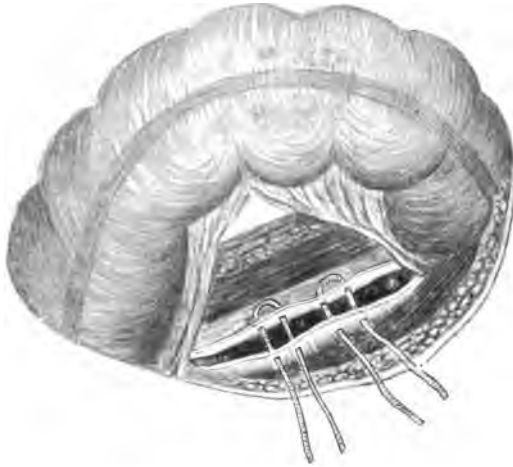
FIG. 102.—THE OPERATION OF COLOTOMY. (A. BALDWIN.)

The stitch has been passed to unite the edges of the peritoneum within the hole torn in the mesosigmoid.

its mesosigmoid. Two silk mattress sutures are next passed, uniting together the opposite edges of the parietal peritoneum within the hole in the mesosigmoid. This is easily done by passing the needle first through the parietal peritoneum on one side, then passing the needle through the hole in the mesosigmoid, then picking up a portion of the opposite parietal peritoneum, then back through the hole in the mesosigmoid, and finally through the peritoneum close to the commencement of the suture.

This is shown in Fig. 102. A second stitch is passed in a similar manner. Two silkworm-gut sutures are then inserted to unite the corresponding portions of skin within the rent in the mesosigmoid. When these sutures are tied, the centre of the wound is united within the hole of the mesosigmoid, and the loop of sigmoid is prevented from slipping back. To prevent any more bowel being prolapsed, and to support the union of the bowel to the abdominal incision, silkworm-gut stitches are passed, uniting the skin to the serous, muscular, and

FIG. 103.—COLOTOMY. (A. BALDWIN.)

The skin has been united within the hole torn in the mesosigmoid. The two stout silk ligatures passed round the sigmoid are used for tying in the Paul's tube.

submucous coats of the sigmoid ; one is placed at each angle of the wound, and one on each side of the mesosigmoid at each end of the loop.

If the operation is done for acute obstruction, it will be necessary to make an opening into the bowel at once. A stout silk ligature is passed through the hole in the mesosigmoid, and an incision is made into the convex border of the loop of intestine. A large-sized Paul's tube is then inserted into this opening, and the silk ligature is tied tightly round the flange of the

tube, strangulating the whole of the circumference of the bowel and the vessels of the mesosigmoid. At the same time another stout silk ligature is passed through the hole in the mesosigmoid, and with this the distal end of the sigmoid is tied tightly close to the abdominal wall, so as to strangulate it. After three or four days this ligature and the one tied round the Paul's tube will cut through the sigmoid, close to the abdominal wall at each end of the incision, and the loop of gut will slough, leaving the openings completely separated by a bridge of skin, and flush with the abdominal wall.

In chronic cases, where it is not necessary to open the bowel at once, the two stout ligatures are passed through the hole in the mesosigmoid at the time of the operation, and their ends knotted together separately. At the end of three days an opening is made in the convex surface of the loop of sigmoid, a Paul's tube inserted and tied in, and the distal end strangulated with its ligature as before described. This can be done without an anæsthetic, as there is no pain when incising the sigmoid; the only pain which will be felt will be when the ligature is tightened round the bowel, and the mesosigmoid constricted. There is no trouble with bleeding, since the incision is made in the convex border of the sigmoid, where there are no vessels of any importance, and the division of the mesosigmoid and mesenteric portion of the gut is effected by means of ligatures, all the large vessels being included in and controlled by these ligatures. The rectus muscle will be found to have considerable sphincter action over the new opening, and patients are able to retain their motions to a certain extent.

Operations on Gangrenous Bowel caused by Strangulated Hernia or by Internal Strangulation

1. **Hernia.**—It is often difficult to determine whether the bowel is really gangrenous or not, and in case of doubt it is better only to reduce the bowel very carefully, leave it near the opening, and pass a gauze drain into the canal. The damaged bowel will form adhesions in the neighbourhood of the hernial sac, and, if the bowel should give way, no extravasation into the general peritoneal cavity will take place. Mere blackness of the gut does not mean gangrene, and in many cases the gut recovers its function. The important points, however, are the absence of any shine in the peritoneal coat, and ulceration or deposit of lymph about the neck of the sac.

If, of course, there be any free gas, or offensive odour, or pus in the sac, there will be no doubt of the occurrence of gangrene, and some operative measures are necessary. The operative procedure will depend a good deal on the condition of the patient. If the patient is much collapsed, a simple opening should be made in the gangrenous knuckle of the bowel, and a medium-sized rubber tube passed into the bowel above the strangulated portion, and the intestinal contents conducted away from the wound. The tube is stitched to the skin incision, and the rest of the wound left open and packed with gauze. In this way the intestinal contents will pour out of the tube, and will not foul the wound. If the patient rallies from the operation, you will then have to deal with an artificial anus, the treatment of which will be described later.

If, on the other hand, the patient's condition is good, an immediate resection of the gangrenous portion of the intestine should be performed. To do this, it is absolutely

essential to open up the ring completely, and to make a free incision into the abdominal cavity. Before doing this, the sac must be well cleansed with weak tincture of iodine or peroxide of hydrogen solution, and the ring must be very carefully divided from without inwards, as any introduction of a finger or even director into the ring might cause rupture of the gut. It is, however, better to make a free incision extending up from the sac, and to open the abdomen above the ring, and then to carefully divide this from above downwards and from without inwards. Very great care must be taken when the sac has been laid into the general peritoneal cavity to prevent any fouling of the peritoneum by its gangrenous contents. The general cavity should be shut off with towels or large swabs before the gut is lifted up. The gangrenous knuckle is then brought outside the abdomen, and is clamped at least 6 inches above and below the strangulated portion, while two pairs of pedicle clamps are applied close to the gangrenous portion. It is very important to remove a considerable amount of bowel on each side of the strangulation, so as to insure that the portion which is joined is quite healthy, and has a proper blood-supply. About 3 inches on each side is the usual amount. The management of the mesentery will depend upon whether the mesenteric vessels are thrombosed. If the vessels are thrombosed, a V-shaped piece of mesentery of sufficient extent to include the thrombosed vessels should be removed with the strangulated knuckle ; if the mesenteric vessels are not thrombosed, the mesentery should be divided close to the bowel, and all vessels ligatured. The bowel is then divided about 1 inch from the clamps, and the piece of strangulated bowel and the apparently healthy gut on each side are removed. The ends of the gut are carefully cleaned with saline lotion,

and are then united, either by a double row of inter-
rupted sutures or by double continuous sutures, after
the application of the usual guides.   In cases where time
is of moment, a Murphy's button may be used.   It must,
however, be remembered that in cases of gangrenous
herniæ there is sure to be a considerable amount of
dilatation of the gut above the obstruction, and probably
ulceration of its mucous membrane, so that there is a
risk that the pressure of the foreign body will aggravate
the ulceration, and lead to perforation.

2. **Internal Strangulation.** — In cases of internal
strangulation when the gut is gangrenous, it is always
necessary to bring the gangrenous knuckle of intestine
outside the abdomen, and then the condition of the
patient will determine the method of treatment to be
adopted.   If the patient is collapsed, the gangrenous
knuckle should be fixed outside the abdominal wound,
and an opening should be made into the gut just above
the gangrene, and a small Paul's tube inserted in the same
way as described for enterostomy.   It is unnecessary to
remove the gangrenous gut, as this will separate of itself.
The knuckle should be fixed to one angle of the incision
by four or five sutures passing between the healthy gut,
above and below the gangrene, and the parietal peri-
toneum ; the rest of the wound is then closed, and the
gangrenous knuckle dusted with iodoform.   If the patient
rallies from the operation, the Paul's tube and the gan-
grenous gut will separate within three or four days, and
then we shall have an artificial anus to deal with.

If the patient's condition is good, the gangrenous bowel
should be brought outside the abdomen, and should be
excised, and the two ends of the gut united by end-to-end
anastomosis, care being taken to select healthy parts of
the intestine for the anastomosis.

In some cases of internal strangulation the congested bowel may become torn even when it is not gangrenous, and in these cases it is quite useless to suture the rent in the bowel. The whole constricted loop and healthy bowel on each side must be excised if the patient can stand the shock ; if not, the knuckle of gut must be stitched to the angle of the wound, and a Paul's tube tied in.

The Operative Treatment of Intussusception

If the intussusception has existed for more than twelve hours, it is very unlikely that it can be reduced without an operation, but if the case is seen very early, an attempt may be made to reduce it by means of an injection. In using injections it must be remembered that the capacity of the colon in infants is not more than about 10 ounces, and in a child of three or four years it will be from 1 to 2 pints. In giving an injection, too, no force must be used, and it is better to give it entirely by gravity, using a funnel which is raised only a few feet from the bed ; a syringe is not suitable, as it is difficult to control the force of the stream. The best fluid to use is either milk and water or saline solution, as either will become partially absorbed, and so diminish the shock.

If the intussusception is not reduced immediately by these means, the abdomen must be opened, preferably over the seat of the swelling. The intestines must be pushed on one side in order to obtain a view of the tumour, as its vitality must be proved before any attempt is made to reduce it, since reduction of a gangrenous intussusception would be certainly fatal. If the bowel appears fairly healthy, and there is no lymph about the neck of the intussusception, the parts may be con-

sidered to be not firmly adherent, so an attempt should
be made to reduce the intussusception.   The way to do
this is to gently squeeze the portion of gut containing the
apex of the intussusception, and to try and reduce this
from below upwards.   Great care is required not to cause
damage to the walls of the gut, since it is not difficult to
rupture the inflamed intestine if too much force be
employed.   On   the   other   hand,   some   considerable
amount of pressure is needed to reduce the œdema of
the apex.   On no account must any attempt be made to
reduce the intussusception by pulling on the intussus-
ceptum, as this will certainly not succeed, and is a very
dangerous proceeding, being often followed by rupture of
the bowel.   If the intussusception cannot be reduced by
pressure and taxis, the following methods may be em-
ployed : (1) An artificial anus may be made above the
intussusception.   This would be effected by tying in a
Paul's tube, as described above, and would only be a
temporary measure.   The intussusception would require
to be removed at a subsequent operation, and the
artificial anus closed.   (2) An anastomosis may be made
between the portions of bowel coming to and going from
the intussusception.   This would best be done by the
method for lateral anastomosis by double continuous
suture.   Although it is a serious measure when a patient
is collapsed, it is not so severe as the alternative one.   It
is open to the objection that a gangrenous piece of gut
is left inside the peritoneal cavity, and the sheath of the
intussusception may rupture when this separates. (3) The
intussusception may be excised, and the ends of the gut
united together.   This may be done in the following way :
An incision is made in the convex border of the sheath
of the intussusception, exposing the whole intussuscepted
portion ; this is turned out of the incision, and is trans-

fixed close to its neck by two needles armed with stout silk sutures. The intussusception is then cut away just beyond these two sutures, and bleeding points in the mesentery are ligatured. When the intussusception is cut away, the two sutures will be seen running across
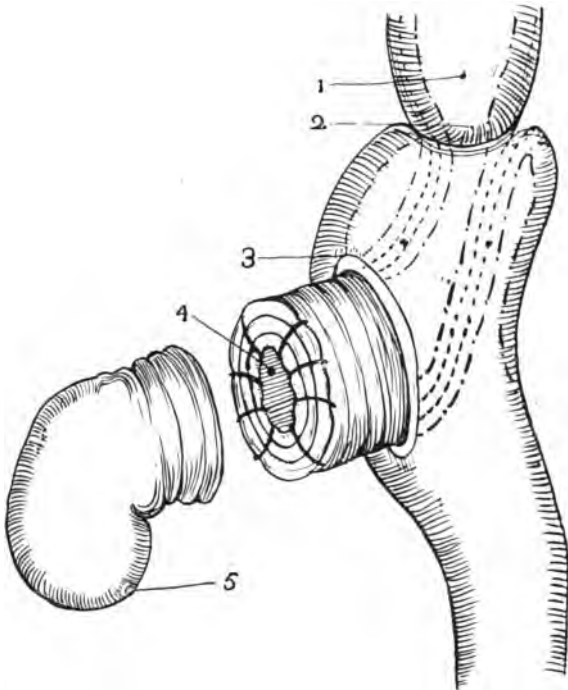
FIG. 104.—THE METHOD OF EXCISING AN INTUSSUSCEPTION THROUGH AN INCISION IN THE INTUSSUSCIPIENS. (AFTER GREIG SMITH.)

1, Entering bowel ; 2, neck of intussusception ; 3, incision in intussuscipiens ; 4, cut edge united with suture ; 5, apex of intussusception excised.

the lumen of the invaginated bowel ; these sutures are then picked up with a blunt hook, and each is divided at its centre, leaving four sutures passed through all the coats of both pieces of intestine ; this exactly resembles the procedure in Maunsell's operation. This is shown

in Fig. 104. These sutures are tied, and other similar sutures are inserted to complete the row. A continuous Lembert's suture is then inserted round the neck of the intussusception, and the incision in the sheath of the intussusception is closed with a row of Halsted's sutures. The mortality of the operation is very great.
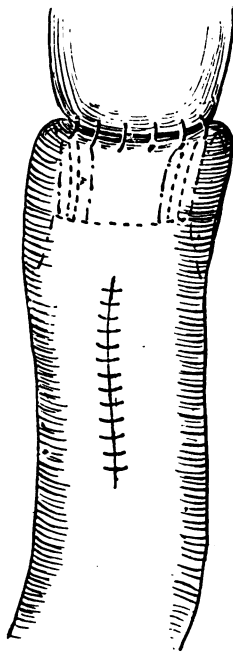
FIG. 105.—EXCISION OF AN INTUSSUSCEPTION.
The operation completed.

This method is open to the objection that the suture is carried out in a portion of the intestine which has been damaged by the obstruction. The incision in the sheath is the real source of danger, as this part has had its vitality impaired, and union is likely to be imperfect, but as adhesions have probably already formed at the neck of the intussusception, leakage will probably not occur at

this point. Finally, there is likely to be considerable constriction at the line of suture of the two ends. It is chiefly indicated in cases of ileo-cæcal or ileo-colic intussusception, when we have to deal with pieces of gut of different sizes. In cases of irreducible intussusception of small intestine, it is preferable to completely remove the intussusception, dividing the bowel a few inches above and below the limits of the intussusception, so as to operate on healthy gut. After division of the bowel on either side of the intussusception, the mesentery is divided close to the gut and ligatured : the two cut ends are now brought together by the method for end-to-end anastomosis by continuous or interrupted sutures with guides. This should take very little longer than the other method, and I have successfully employed it in a child aged four years.

The Treatment of Artificial Anus or Fæcal Fistula

The difference between these two terms is rather vague. The term ' fæcal fistula ' is sometimes applied to any communication between the small intestine and the abdominal wall, and the term ' artificial anus ' confined to a similar condition of the large bowel. I think, however, that the term ' artificial anus ' should apply to any intentional opening made into the bowel, whether large or small, and the term ' fæcal fistula ' kept for communications which arise in consequence of ulceration or of faulty suturing. There is a considerable amount of difference in the treatment of an artificial anus in the small and large intestines.

1. **Artificial Anus of Small Intestine.**—This condition is of a serious nature, and urgently calls for some operative treatment, both on account of the distress caused by the continual passage of liquid motions from the wound,

and also from the fact that patients rapidly emaciate when there is an artificial anus in the small intestine. Of course, this interference with nutrition will be more marked the higher up in the intestinal tract that the opening is situated.

There are three principal methods of dealing with an artificial anus in the small intestine :

(1) Resection of the whole piece of gut containing the opening, and an end-to-end anastomosis of the afferent and efferent portions of gut.

(2) A lateral anastomosis between the afferent and efferent portions of gut combined with occlusion of the afferent portion of the gut between the anastomosis and the artificial anus.

(3) The application of an enterotome, either Dupuytren's or Mickulicz's.

In any operation for the relief of this condition it must be remembered that, although the artificial anus was originally made by an opening only in the convex border of the gut, the loop of intestine may have been so much pulled on that a well-marked spur may have developed, and the passage of fæces onwards past the artificial anus will be effectually prevented ; simple closure of the opening will not then be of any use. Secondly, it must be borne in mind that any operation is useless when there is any obstruction below the opening.

(1) In the first method referred to the artificial anus should be well purified, and then plugged with gauze soaked in tincture of iodine, and its edges sewn together with silkworm-gut sutures over the gauze plug. The opening itself is covered with acetone collodion. An incision is made all round the artificial anus, and continued above or below it for about 1½ inches; the peritoneum is opened at the extreme end of the incision, and

the adherent knuckle of gut carefully freed from the abdominal wall. The part is then examined, and the amount of loss of substance of the wall of the gut is estimated, and also the amount of contraction which would be caused by suturing the wound left after dissecting out the artificial anus. This will usually be very considerable, and such a method of treatment will be out of the question. It will therefore be necessary to do a modified resection. The bowel must be clamped above and below the artificial anus, leaving at least 3 inches of healthy bowel on each side between the clamps and the opening.

It probably will not be necessary to divide the mesenteric portion of the intestine; the gut will therefore be divided in an oblique direction from the convex border to within ½ inch of the mesentery on either side of the artificial anus, and the intervening portion of gut removed; the vessels in the coats of the bowel are tied.

The guides are then inserted at the convex border and close to the mesentery, and the gap in the bowel is brought together in the way recommended for end-to-end anastomosis. In cases where the mesentery has become puckered or adherent, it may be necessary to do a complete excision and end-to-end anastomosis.

(2) In the second method there is less risk of fouling the peritoneal cavity. The artificial anus is purified and plugged, and the skin sewn over it. An incision is then made into the abdomen about 1 inch to one side of the artificial anus, and the peritoneum opened. The loops of gut going to and coming from the artificial anus are then identified, and a lateral anastomosis is made between these about 3 inches from the opening. The lateral anastomosis is best made by continuous sutures and guides. The afferent portion of gut between the

anastomosis and the artificial anus is then occluded by dividing it as described on p. 31. It is not necessary to occlude the portion of the bowel on the distal side of the artificial anus. In this operation a small sinus is left at the site of the artificial anus, which will continue to discharge a small amount of mucus for some time, but will not give rise to much trouble. It will contract to a pinhole in a short time.

(3) In the third method the spur formed between the afferent and efferent portions of gut is divided by means of an enterotome. This leaves one large opening into the intestine, which is closed at a subsequent operation.

The best-known enterotomes are Dupuytren's and
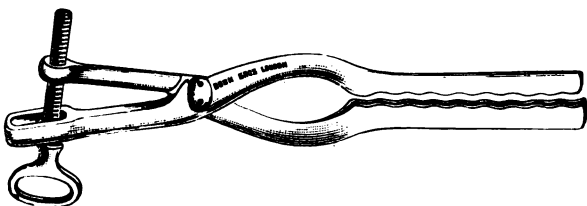
FIG. 106.—DUPUYTREN'S ENTEROTOME.   (DOWN BROS.)

Mickulicz's. A third one, which is a combination of the two, has recently been invented by Carwardine. Dupuytren's enterotome is shown in Fig. 106. It consists of two blades which take apart, and each is introduced separately into the afferent and efferent portions of the gut. They are then united at their joint, and the blades are brought together by tightening the screw. This should be done very carefully, and at first only sufficient pressure should be employed to keep the enterotome in place. If more pressure is used the enterotome would cut through the coats of the bowel too quickly and extravasation would take place. The screw of the enterotome is tightened one half-turn every day, and

the instrument will be found to have cut through by the fifth or sixth day, by which time firm peritoneal adhesions will have formed. We shall then have a free channel between the afferent and efferent loops of intestine, and a certain amount of fæces will go by the proper channel past the artificial anus. It will, however, be necessary to complete the operation after an interval of a fortnight by closing the artificial anus. An incision is made around the edge of the artificial anus, and the walls of the bowel are dissected up for about $\frac{1}{2}$ to $\frac{3}{4}$ inch all
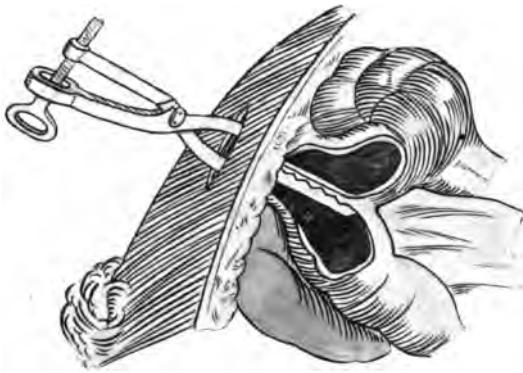
FIG. 107.—DUPUYTREN'S ENTEROTOME APPLIED AND DIVIDING THE SPUR.

round. The edges of the mucous membrane are united by a row of sutures whose knots are inside the intestine, and the other coats are united by two or three rows of Lembert's stitches. Lastly, the edges of skin at each end of the incision are brought together with sutures, but it is better to leave the central part of the incision open and loosely packed with gauze, in case some leakage should occur. The greater part of the suturing will probably hold, but often a small fæcal fistula is left, which, however, will gradually contract, and will not give rise to much

trouble. Its closure may be hastened by touching it with a galvanic cautery.

Comparison of the Different Methods.—Much will depend upon the amount of adhesions which have formed around the artificial anus, since either of the first two methods may prove exceedingly difficult when adhesions are dense. In an ordinary case, however, I should be inclined to recommend the first operation—namely, the partial resection of the intestine followed by an end-to-end anastomosis—as being the safest and the least likely to lead to any cicatricial contraction. If, however, there is so much matting that the peritoneum cannot be opened by an incision 1 inch above the artificial anus, then the second method of lateral anastomosis may be resorted to.

The objections to the resection operation are the risk of contamination of the peritoneum, the danger of subsequent stricture, or of failure of union of part of the anastomosis. The third method, by the use of an enterotome, is scarcely ever likely to be used for the small intestine, since an artificial anus in this position does not usually have any spur. It is not to be recommended when dealing with the small intestine, since it is very difficult to avoid including the mesenteric border of the gut in the enterotome, and the sloughing of this part may lead to dangerous hæmorrhage or extravasation.

2. **Artificial Anus of Large Intestine.**—This condition will remain (1) after the removal of a growth of the large intestine; (2) after a colotomy for an irremovable growth, or for intestinal obstruction from other causes, such as volvulus of the sigmoid; or (3) after ulceration of the cæcum in some cases of appendicitis or ulcerative colitis. The distress occasioned will be greater the nearer the opening is to the cæcum, on account of the liquid nature of the fæces, so an operation is most urgently

called for when the opening is in the cæcum. I am, however, strongly of opinion that an artificial anus should be closed in every case where there is enough healthy bowel below the seat of obstruction, to allow a sufficient space for the performance of a lateral anastomosis.

We need only consider three methods :

(1) If there is no spur, and very little loss of substance in the bowel, the artificial anus should be dissected free from the abdominal wound, and the bowel freed from its adhesions.. The opening is then closed by a double row of sutures passed in such a way that the scar is at right angles to the long axis of the bowel.

(2) In cases where there is a definite spur, or where the colon has been completely divided, and the opening into the two ends are distinct, an enterotome may be employed. This is used in the same way as described for artificial anus of the small intestine. This is more suitable for the large than for the small intestine, as it is more likely that a portion of the intestinal wall away from the mesentery (and therefore covered with peritoneum) will be included within the blades of the enterotome, and so no damage will be done to the mesentery. It is, however, only possible in cases of artificial anus where there is no obstruction beyond. The resulting opening will have to be closed in the way just described. I only employ it in cases of removal of a growth in the splenic flexure or in the descending colon, where an end-to-end anastomosis is impossible.

(3) By far the best method of closing an artificial anus of the colon, however, is the performance of an ileo-sigmoidostomy, and this operation is possible in any case where the obstruction is situated above the lower third of the sigmoid. The artificial anus is carefully plugged and sewn up as described above, then an incision

is made along the outer border of the left rectus muscle, and the ileum found and united to the sigmoid, as described on p. 110.

When this operation is performed for the relief of an artificial anus it will always be necessary to occlude the ileum between the anastomosis and the cæcum, as described on p. 31. It will not be necessary to do anything to the artificial anus itself, as this will shrivel up, and nothing but a minute pin-point orifice will be left, through which there is an occasional discharge of mucus. I have never had any troublesome discharge of fæces by regurgitation, except where the artificial anus was within an inch or so of the anastomosis. It is better not to attempt to absolutely close the opening in the short-circuited large intestine, as there would be a danger of accumulation of mucus, and of inflammation taking place in the cæcum.

The Treatment of Cancer of the Colon

In acute obstruction an operation is clearly indicated, and is urgently called for, to save life. In cases of suspected growth, where the symptoms are not at all acute, an exploratory operation should be performed.

In the first place, I should like to protest emphatically against the formation of an artificial anus, except as a temporary measure. I have often witnessed the distressing condition of a patient with an artificial anus at the beginning of the colon, and I am inclined to think that death may be preferable to such a condition. The ideal operation, of course, is the removal of the growth, combined with an intestinal anastomosis. This is possible in the case of any growth which is not firmly adherent to neighbouring parts, and in which there is not irremovable enlargement of glands. In order to

thoroughly remove the growth, it may be necessary to excise portions of neighbouring organs. I have excised a growth of the transverse colon to which was adherent a coil of ileum and the bladder, and portions of both of these viscera had to be removed ; Pollard also mentions a case where he had to excise a kidney which was infiltrated by a growth of the descending colon. Granted that the growth is sufficiently free to be removed, the simplest method, no doubt, is to excise it, and to unite the cut ends by an end-to-end anastomosis. There are, however, considerable objections to this procedure, except in the case of the sigmoid and of the transverse colon, since the walls of the remainder of the colon are uncovered by peritoneum to so great an extent that the union is not very secure, and, moreover, there is likely to be a considerable strain on the stitches on account of the solid character of the intestinal contents.

An alternative method of dealing with the bowel after excision of the growth is to close both cut ends of the colon and to re-establish the intestinal channel by means of a lateral anastomosis between the ileum and the colon. In some cases I have performed a lateral anastomosis at a first operation, and have removed the growth at a subsequent operation, but my experience with this method has not been fortunate, since in some cases of carcinoma of the cæcum in which I did a preliminary ileo-colostomy the patients did very well after this operation, but on attempting to remove the growth after an interval of fourteen days, the tumour was found to have contracted fresh adhesions, and the removal became much more difficult than it would have been at the original operation. In other cases so much relief was afforded by the ileo-colostomy that further operation was refused.

The method to employ will depend upon the portion of

the gut in which the growth is situated. When the growth is situated in the cæcum, the ileum should be divided between two clamps about 3 inches from the cæcum, and its proximal end occluded. A lateral anastomosis should now be made between the occluded end of the ileum and the transverse colon, taking care to secure iso-peristalsis. The peritoneum is now divided on the outer side of the cæcum and of the ascending colon, which will render the bowel freely movable. The mesocæcum and mesocolon are now divided between pressure forceps, and ligatured. A small portion of the mesentery of the divided ileum will also require division and ligature. The ascending colon is now divided between two clamps at some distance from the growth, and the distal end occluded. The growth is now removed with its mesocæcum and glands. The cut mesocæcum and mesocolon are next united to the parietal peritoneum.

In the case of a growth in the transverse colon, practically the whole of the transverse colon will have to be removed, since, in order to remove the affected glands, it will be necessary to take away so large an amount of mesocolon that the vitality of the transverse colon would be affected. The greater part of the great omentum must also be removed. The transverse colon is therefore divided between clamps about 2 or 3 inches on each side of the growth, and a V-shaped piece of the transverse mesocolon removed. An end-to-end anastomosis is then performed between the cut ends of the transverse colon by double continuous sutures with guides. The V-shaped incision in the transverse mesocolon is closed.

In the case of a growth in the splenic flexure or descending colon an end-to-end anastomosis is impossible, and after the growth has been removed, the two cut ends may be brought out of the wound with a Paul's tube tied in

each, as recommended by Mickulicz (in this case the restoration of the intestinal channel may be effected by division of the spur by means of an enterotome) ; or the divided ends of hte colon may be closed and invaginated on themselves, and a lateral anastomosis effected between the ileum and sigmoid. I am inclined to advise that the loop of gut containing the tumour should first be removed, together with its mesocolon, the incision through the gut being at least 1 inch from the growth. The mesentery, too, should be divided at some distance from the gut. When the loop of gut containing the growth has been freed from its adhesions and brought outside the abdominal incision, a circular purse-string suture is passed through all the coats of the bowel, picking up the mesocolon, about $1\frac{1}{2}$ inches above the growth ; an incision should then be made in the convex border of the gut $\frac{1}{2}$ inch below the suture, and a Paul's tube slipped in and tied in position with the purse-string suture, which has the effect of stopping all bleeding. The gut is now completely divided below the Paul's tube, after clamping the end of the gut below the tumour, and the growth removed. The cut end of the distal portion of the gut is then invaginated on itself and closed with two layers of sutures, and dropped back into the abdominal cavity. The proximal end of the gut, with the Paul's tube *in situ*, is stitched to the parietal peritoneum by the insertion of three or four silk sutures.

If the patient is in a sufficiently good condition after this stage of the operation to stand another half-hour's anæsthetic, I immediately proceed to do a lateral anasto-mosis between the lower part of the ileum and the sigmoid, as described on p. 110. If the patient is suffering from shock after removal of the growth, the anastomosis may be deferred until a second operation, which should be performed about two or three weeks after the first.

of fæcal contents. It is only when the growth is fixed·in the pelvis, and there is no free gut below it, that a colotomy should be done ; it is an operation that is to be avoided if possible. When colotomy is unavoidable, the loop of bowel should be opened during the operation, and a Paul's tube tied in, since it is most important to relieve the obstruction at once, and if the fæces be conducted away from the wound by means of rubber tubing attached to the Paul's tube, no infection of the wound will result.

If the sigmoid be found to be empty, I turn immediately to the cæcum and examine this. If the cæcum is distended, by tracing the distended gut upwards the growth may be found ; but no extensive search should be made, if there is much general intestinal distension. If a growth is found in the ascending colon and it is movable, an incision should be made over it, and it should be treated in the same way as I have described for a sigmoid growth. After removal of the growth. and when the intestinal distension has subsided, it is best either to do an ileo-sigmoidostomy, or to unite the ileum to the transverse colon, or to attempt to restore the canal by means of an enterotome. In cases where there is great distension of the small intestine, and the patient's general condition does not warrant any prolonged search for the cause of the obstruction, the correct treatment is relief of the obstruction by making an artificial anus in the cæcum or in the last part of the ileum. It is preferable to make the opening in the latter position, as the artificial anus is easier to close when the obstruction is removed. The enterostomy is performed by tying in a Paul's tube, as described on p. 113.

After an enterostomy, the intestinal distension will subside in the course of twenty-four hours, and it will then be easy to locate the position of the growth. This

must be dealt with according to the methods recommended on p. 135, and the artificial anus closed after the growth has been removed, or the bowel short-circuited.

Anastomosis operations performed during acute obstruction have not the same freedom from risk as those performed during the quiescent period, and so should not be performed except in cases where the portions to be united are at some distance from the seat of obstruction.

In cases where the growth of the cæcum or colon is fixed, or there is infection of the peritoneum, I do not advise a preliminary colotomy, as the distress occasioned to the patient by the passage of liquid fæces is very considerable, and in an incurable case, when the duration of life is likely to be short, it is hard to submit the patient to two abdominal sections. I therefore think it right to do an ileo-sigmoidostomy at the first operation, in spite of the slightly additional risk. This operation gives immediate relief, and in most of my cases fæces have been passed *per anum* within a few hours of the termination of the operation. Although, as I stated, the risk of an ileo-colostomy is greater in cases of acute obstruction than during the quiescent period, I do not think that it is much greater than that of colotomy under similar conditions. The cases which recover have no further symptoms of obstruction, and the ultimate results are not unsatisfactory, the patients living for three to eighteen months after the operation.

The points upon which I wish to lay stress are : (1) That an early exploratory operation should be advised in any case presenting even vague symptoms of carcinoma of the colon ; (2) that when there is no obstruction the growth should be removed at once at the time of the exploratory operation, and that the re-establishment of the intestinal canal should be done at once, or after an

interval of a few weeks ; (3) that colotomy should never be performed, except in cases of an inoperable growth, in the lower part of the sigmoid ; (4) that in any irremovable growth situated above the middle of the sigmoid flexure an ileo-sigmoidostomy should be performed, instead of colotomy.

CHAPTER VI

OPERATIONS ON THE APPENDIX VERMIFORMIS

CONSIDERING the importance of the vermiform appendix in modern surgery, and the frequency with which the surgeon is called upon to deal with the organ, I have devoted a chapter to the measures which I consider should be employed in operations for trouble connected with the appendix. It does not, however, fall within the scope of this small handbook to discuss the pathology and etiology of, or indications for operation in, appendicitis; but I shall confine my remarks to the actual operations which require to be performed.

There are several conditions of the appendix which call for operation :

1. Acute general peritonitis due to perforation of an inflamed gangrenous appendix.

2. Gangrene of the appendix without general peritonitis.

3. Acute appendicitis, when seen within twenty-four hours of the commencement of the attack.

4. Abscess in connection with the appendix.

5. Recurrent attacks of slight appendicitis, the history of one severe attack, persistent pain in the region of the appendix, or the persistence of a sinus after opening an abscess.

6. The so-called appendicular dyspepsia.

1. In acute general peritonitis due to a perforated appendix an operation must be performed with as

little delay as possible. The abdomen should be opened by an incision one finger's breadth inside the outer edge of the right rectus, and after separating the fibres of the rectus muscle, the posterior rectus sheath should be divided and the peritoneum opened. Pus will then well out ; this should be wiped away, but irrigation should not be done until drainage has been provided, a search is then made for the appendix, which will usually be found to be gangrenous or perforated. It must be gently lifted into the wound and wrapped in gauze while its mesentery is ligatured. No time should be wasted in forming a cuff of peritoneum, but an incision should be made through the peritoneal coat round the appendix about ½ inch from the cæcum, and the rest of the coats ligatured with a catgut thread after they have been crushed with pressure forceps. The appendix is then clamped on the distal side of the ligature, and is cut off ; the ligatured end is touched with pure carbolic acid. A couple of Halsted's or Lembert's sutures are inserted close to the mesocæcum to invaginate the end of the appendix.

The question of drainage and irrigation of the peritoneal cavity will depend upon the length of time during which the perforation has existed, and the extent of peritoneum which is involved. In mild cases it will only be necessary to thoroughly wipe away the pus with sterilized mops soaked in saline solution. This must be done till no trace of pus can be seen. Afterwards the abdominal wound should be closed. Although it is possible to sufficiently cleanse the peritoneum so as to prevent any further peritonitis, it is practically impossible to prevent infection of the abdominal wound with *Bacilli coli*, and so some drainage must be provided. This drain should extend down to the peritoneum, but not into the peritoneal cavity.

In cases in which peritonitis has existed for some time, and there is a quantity of pus in the general peritoneal cavity, it will be necessary to effectively drain the peritoneum.

There are three places in which it is necessary to drain. The first of these is the right loin. This is absolutely essential in every case of general peritonitis from appendicitis. The way in which this opening is made is by means of an incision through the skin, in the interval between the last rib and the crest of the ilium, behind the posterior axillary line. The incision is made an inch in length. A pair of large forceps is then taken and pushed by a boring motion through the muscles till its point presents under the parietal peritoneum. The finger of the disengaged hand is passed into the wound, and feels the forceps beneath the peritoneum. By keeping the finger upon the point of the forceps the operator can insure that no damage is done to the cæcum. When the pair of forceps has been pushed into the peritoneal cavity its point is made to present into the abdominal wound, and a piece of drainage-tube is caught by the forceps and dragged across the peritoneal cavity, and brought out of the lumbar wound ; the portion which is inside the abdomen is directed upwards, the purpose being to drain the right subphrenic space. A similar lateral drain is then made on the left side. The tube is introduced in a similar manner, and the left subphrenic space is drained.

We have only one other position for drainage, and that is the pelvis. When pus has collected in the pelvis, the best way of draining it is by means of a rectal drain. The only objection to this is the necessity for the operator himself putting one of his fingers into the rectum ; it is hardly possible to make use of the finger of an assistant

with any assurance. A large pair of forceps is passed
into the pelvis, and with a finger in the rectum we can
feel the points of the forceps through the wall of the
rectum at a point just above the prostate in a male,
situated about ¼ inch from the finger. When the tip
of the forceps is felt as close as that to the finger, we
know that we have got nothing but the wall of the
rectum between the forceps and the finger, and we can
push the forceps through. We push the rectal wall down
towards the anus, bore through the rectum, and the tip
of the forceps presents through the anus. A piece of
drainage-tube is then caught in the open mouth of the
forceps, which are projecting through the anus, and by
means of the forceps the piece of drainage-tube is pulled
either into Douglas's pouch or the recto-vesical pouch,
which it is desired to drain. The tube is left within 1 inch
of the brim of the pelvis, the other end projecting about
1 inch beyond the anus. The tube is grasped by the
rectum and the anus, and is not likely to drop out. It
is usually fixed by a silkworm-gut suture to the skin on
the side of the anus.

Thus we have a complete method of drainage—a
lateral drain in each loin and the pelvic drain. Having
provided drainage, it is now the time to wash out the
peritoneum. A great mistake is made in washing out
the peritoneum before drainage has been provided. Only
one substance is suitable for irrigation, namely, normal
saline solution. With antiseptics there is a risk of
damaging the peritoneal cells, which are already inflamed.
Another objection to antiseptics is that a large quantity
may be absorbed and may poison the patient. When
the intestines are enormously distended they contain
a virulent culture of *Bacillus coli communis*, and it is
quite useless to leave them in the abdomen in this state.

We must open the intestines and empty them of their contents. A large hoop of intestine is brought outside the abdominal wound, and is packed round with towels. An incision of about 1 inch long is then made into the convex border of the intestine, the hand, previously washed in saline, is put into the abdomen, and an endeavour made to milk out into this opened coil as much as possible of the intestinal contents. In this way one is able usually to empty out the greater part of the contents of the small intestine. The wound in the intestine is then sewn up and the coil replaced. Some surgeons have recommended putting in saline solutions after removing the contents, thereby avoiding shock. Having carried out this operation, we close the abdominal wound, leaving a space for drainage, and fix the drainage-tubes in all the openings with gut sutures.

In severe cases of peritonitis the chances of recovery are improved by getting an early action of the bowels after the operation, and as there may be some difficulty in giving aperients by the mouth, it is a good thing to inject some saline aperient directly into the cæcum at the time of removal of the appendix. Two drachms of sulphate of soda dissolved in an ounce of water can be injected into the cæcum with an exploring syringe, the injection being made close to the stump of the appendix before it is invaginated into the cæcum.

The operation should be performed as rapidly as possible, and shock avoided by means mentioned on p. 180. Although the removal of the appendix increases the length of the operation and the shock, it is absolutely necessary, since recovery is unlikely if a gangrenous or perforated appendix be left behind. In the after-treatment the adoption of the Fowler position is most important. The prognosis, though grave, depends upon the

time which has elapsed since the perforation has taken place.

The appendix should also be removed, at once, in cases of gangrenous appendix without general peritonitis and in every case of acute appendicitis, if seen within the first twenty-four hours, when it can be removed with practically as much safety as between the attacks. The operation is the same as that just described, with the exception of there being no necessity to flush out or drain the peritoneal cavity. There is, however, a distinct danger of infection of the abdominal wound, so this must be carefully protected during the operation.

2. **In Cases of Abscess in the Region of the Appendix** an operation will rarely be needed till between the fourth and twelfth day ; about the tenth day is the most usual time. In these cases there is usually a definite swelling, with dulness on percussion ; and as it is most important to avoid opening the general peritoneal cavity, the incision should be made at a little distance within the edge of the dull area. If the dulness does not extend far forwards, the incision must be made nearer the crest of the ilium than the usual incision, the general rule being that the incision should be made in the centre of the dull area.

The abdomen should be opened by an incision one finger's breadth outside the outer edge of the right rectus, and, after dividing the aponeurosis of the external oblique, the fibres of the internal oblique and of the transversalis muscle should be separated with the handle of a scalpel, and the transversalis fascia divided in the direction of the wound. When the fascia transversalis is divided the peritoneum is exposed ; this is usually very much thickened, and often resembles bowel both in appearance and to the touch, and may cause one to hesitate before making an opening into it.

By mistaking the thickened peritoneum for bowel, and endeavouring to separate the peritoneum from the fascia transversalis, instead of the bowel from the peritoneum, we should open up a cellular space where pus will afterwards burrow. It is better, if one feels uncertainty, to puncture the thickened peritoneum first with an ordinary needle, when, if pus be present, it will well up out of the puncture, after which the surgeon need feel no hesitation in making a free opening with a scalpel. If no pus is found, but a piece of gut presenting in the wound has been punctured by the needle, no harm will result, and we shall find the pus by separating the tissues outwards and pushing the bowel inwards. When the abscess cavity has been opened it is much the wisest plan not to make any digital exploration of the cavity until it has been thoroughly flushed out. It is best to insert one or two large-sized tubes as far as they will go, and then to gently wash away the pus with saline solution or with weak peroxide of hydrogen, the fluid being introduced from an irrigator only a foot or so above the wound, and carried to the bottom of one of the drainage-tubes by means of a small rubber catheter ; in this way the cavity is flushed out from within outwards, and there is no danger of any adhesions being broken down. The abscess cavity should then be cautiously explored with the finger, and if a loose concretion from the appendix is found, it should be removed, but no attempt should be made to remove the appendix itself.

In all cases a counter opening should be made. When the abscess is in the iliac region, a counter opening is made in the loin. This is done by making a skin incision 1 inch long above the crest of the ilium, and then pushing a pair of large clamp forceps through the abdominal muscles on to a finger of the left hand, introduced into

the abscess cavity. The point of the clamp forceps is then made to project through the anterior abdominal wound, and a large drainage-tube is grasped by these forceps, and is pulled out of the lumbar incision by withdrawing the forceps ; the tube is guided down into the abscess sac, which is drained through the lumbar opening alone.

No drainage-tube need be placed in the anterior incision, which should be closed with the exception of a space in the centre, where a gauze plug is inserted. When the abscess has tracked down into the pelvis, the lumbar drain alone will not be sufficient. In such cases the pelvis must also be drained. Formerly this was done by making an incision above the pubes and inserting a tube down into the pelvis ; this, however, did not provide satisfactory drainage. The most efficient drainage is provided by means of a rectal drain ; this should be inserted in the way described for treatment of general peritonitis.

In cases of abscess which can be evacuated without opening the general peritoneal cavity, the less you interfere with the parts the better ; the essential thing is to let out the pus and promote free drainage. The prognosis is usually good.

A considerable number of cases of abscess connected with the appendix are situated behind the cæcum, and cannot be opened without going through the general peritoneal cavity. In these cases the procedure is rather different. As the manipulations are likely to be a little difficult, it is best to make a rather free incision at the outer edge of the right rectus muscle. When the peritoneum has been opened, the edges of the wound are carefully protected with gauze pads, the small intestine pushed out of the way and covered with gauze. and a

strip of gauze should be pushed down into the pelvis. The cæcum will present in the wound, and a hard fixed swelling will be felt behind it. The index-finger of the right hand should be covered with gauze, and inserted between the outer surface of the cæcum and the abdominal parietes ; it should carefully break down the adhesions, and work round to the back of the cæcum, where pus will be found : this must be quickly wiped away with gauze mops or gauze. Fortunately, such an abscess is usually quite small, and does not contain more than 1 ounce, or even less, of pus. It is, therefore, easily cleaned out. As the general peritoneal cavity has been opened, the fear of breaking down adhesions while removing the appendix no longer exists ; so when all pus has been wiped away, the cæcum and appendix should be thoroughly freed from their adhesions and brought out of the wound. The appendix is then removed in the ordinary way, and a counter opening made in the loin as described above, and a drainage-tube inserted ; the anterior abdominal wound is closed, with the exception of its centre, where a gauze drain is left.

In some cases the abscess is confined to the pelvis, and the iliac fossa is quite free. Such cases are often very insidious in their onset, and at first no swelling is felt above the pubes ; ballooning of the rectum is a constant sign, and a fluctuating swelling can often be felt *per rectum*. It is practically impossible to drain these cases by an abdominal incision without opening the peritoneal cavity. It is, however, quite simple to drain them by the rectum.

The patient should be put in the lithotomy position, and the sphincter ani stretched ; a large rectal speculum or duck-bill vaginal speculum is introduced, and the anterior wall of the rectum is incised about 3 or 4 inches from the anus. Usually a large quantity of pus escapes ;

a drainage-tube is then pushed through the opening in the rectum into the pelvis, and is stitched to the skin near the anus. The abscess cavity should be washed out with saline solution through the tube. The tube usually remains in for about four days, after which the discharge quickly subsides, and there will probably be no pus passed by rectum after a week.

3. **Removal of the Appendix after an Acute Attack, or for Recurrent Slight Attacks.**—In this operation we have no fear of peritoneal infection, and the chief dangers to avoid are the infection of the wound and the occurrence of a hernia at the scar.

The incision is therefore of importance, and care should be taken not to divide any muscle across its long axis, but simply to separate its fibres.

There are two incisions which may be employed ; the first gives quite sufficient room in ordinary cases, but the second gives more room, and should be employed when extensive adhesions are expected.

(1) An incision between 2 and 3 inches long is made two fingers' breadth outside the edge of the right rectus muscle, the centre of the incision being opposite the anterior superior iliac spine. The aponeurosis of the external oblique is divided in the direction of this incision ; the internal oblique will then be exposed, its fibres running transversely to those of the external oblique and to the abdominal incision. The fascia covering the muscle is divided in one of the white lines indicating the separation between the bundles of fibres, and these bundles are separated by the handle of a scalpel in the direction of the fibres ; this will expose the aponeurosis of the transversalis muscle. The fibres of the internal oblique are forcibly held aside with retractors, and an incision in the same direction as the skin wound is made in the aponeu-

rosis of the transversalis muscle, exposing the peritoneum. After this has been opened in the direction of the skin wound, the cæcum will usually present in the wound ; this is shown in Fig. 108. Occasionally some adherent omentum is first seen, which must be separated and ligatured. The cæcum should be brought outside the wound,

FIG. 108.—INCISION THROUGH THE PARIETES IN APPENDICECTOMY.
(A. BALDWIN.)

The fibres of the internal oblique muscle are separated by retraction, and the cæcum exposed.

exposing its junction with the ileum. The origin of the appendix will probably be discovered by following down the band of longitudinal muscular fibres on the anterior surface of the cæcum. This is continued on to the walls of the appendix. If the appendix is not seen at once, the finger must be introduced into the abdomen, and passed

in front, below, and outside the cæcum to search for the appendix. When it is found, it should be hooked up outside the wound, and recent adhesions separated with the finger covered with gauze.

If the appendix cannot be found, or, when found, cannot be brought out of the wound, it is best to pull out a few inches of the termination of the ileum, and by drawing on this and on the cæcum the origin of the appendix will usually be brought into view, and the rest of the appendix can be hooked out of the wound
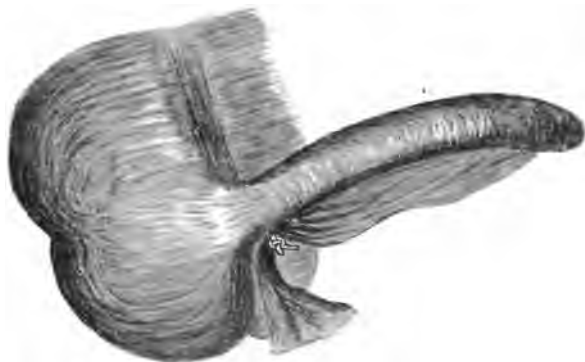
FIG. 109.—THE METHOD OF SECURING THE MESO-APPENDIX BY ONE LIGATURE AT THE ROOT OF THE APPENDIX. (A. BALDWIN.)

with the finger. When its mesentery is exposed, it is clamped with two or three pairs of artery forceps, and then divided between the appendix and the forceps. The clamped mesentery is ligatured with fine silk. When the appendix is not adherent or kinked, the mesentery may be dealt with as shown in Fig. 109, where only one ligature is applied close to the root of the appendix.

The appendix must now be removed. A circular incision is made round the appendix through the serous and muscular coats about $\frac{1}{2}$ inch from its junction with the cæcum ; this cuff is reflected back as far as the cæcum,

as shown in Fig. 110. The portion of the appendix denuded by the cuff is then crushed by the temporary application of a pair of artery forceps close to the reflection of the cuff, and the crushed portion is tied with a catgut ligature ; a clamp is then applied to the appendix, just external to the ligature, so as to prevent any escape of its contents during removal, and the appendix is divided between the clamp and the ligature. The stump is touched with some pure carbolic acid, applied with a small wisp of wool, the end of the catgut ligature is cut short, the cuff is

FIG. 110.—REMOVAL OF APPENDIX. (A. BALDWIN.)

Peritoneal cuff dissected back, muscular and mucous coats ligatured, and artery forceps applied beyond the ligature previous to removal.

brought forward, and one silk suture is inserted to unite its edge. The stump now requires to be invaginated into the cæcum, and to do this two or three Lembert stitches are inserted into the cæcum, ¼ inch from the base of the appendix ; when these are tied, the appendix will be invaginated, as shown in Fig. 111. (N.B.—The suture nearest to the meso-appendix must be tied first.)

The appearance of the invaginated stump as seen in section through the cæcum is shown in Fig. 112.

The stump of the ligatured meso-appendix should also be buried with Lembert's sutures.

Some warm saline solution should now be run over the

cæcum and the scar of the appendix, and the parts should be reduced into the abdominal cavity. The wound through the abdominal parietes must be very carefully closed.

In uniting the peritoneum, the omentum will often be

FIG. 111.—REMOVAL OF APPENDIX. VIEW OF STUMP AFTER INVAGINATION.

found to get in the way, as it has a great tendency to become prolapsed between the edges of the wound; I find, however, that this difficulty can be avoided by catching hold of the edges of the peritoneum at the
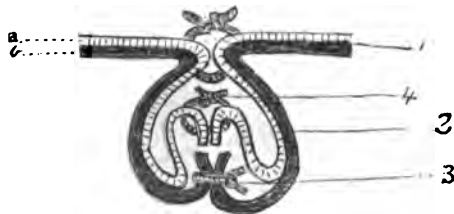
FIG. 112.—REMOVAL OF APPENDIX. DIAGRAM OF SECTION OF INVAGINATED STUMP.

a, Serous coat; b, muscular and mucous coats. 1, Wall of cæcum; 2, invaginated stump of appendix; 3, ligature round mucous and muscular coats of appendix; 4, suture of peritoneal cuff of appendix.

two ends of the incision with four pairs of Spencer Wells forceps, and holding them up so as to separate the peritoneum from the viscera. It will then be found easy to pass the stitches. Two or three mattress

sutures, or a continuous suture of fine silk or of Pagen-stecher's thread, are then introduced and tied, as described on p. 162. The wound is then washed with some antiseptic solution, such as biniodide or perchloride of mercury solution, so as to counteract any infection which may have occurred during the removal of the appendix. The fibres of the internal oblique are united with a couple of silk sutures, and the aponeurosis of the external oblique with a continuous silk suture. The skin wound is closed in the ordinary way.

The alternative incision, which may be employed when it is expected to find dense adhesions, is made along the outer border of the rectus muscle ; the linea semi-lunaris should be avoided, as it is more difficult to suture afterwards. An incision about 3 inches long is made one finger's breadth inside the right linea semilunaris, and the anterior sheath of the rectus is opened. The muscle is then either pushed inwards or some of its fibres separated, and an incision made in the posterior sheath of the rectus, exposing the peritoneum, which is then opened. In this way a very free opening can be made. The operation is proceeded with in the same way as described above. The wound is closed in the way described on p. 162.

The special points to pay attention to in this operation are : (1) To make as small an incision as possible ; (2) to thoroughly divide all adhesions in the region of the cæcum ; (3) to remove the appendix quite close to the cæcum ; (4) to invaginate the stump within the cæcum ; (5) to prevent any possibility of hernia at the scar ; and (6) to prevent any infection of the wound during or after removal of the appendix—this is done by covering the wound and the cæcum with sterilized cloths while removing the appendix, by throwing away any mop

used for the cut mucous membrane, by not using any instrument which has been used in severing the appendix for the remainder of the operation, and, finally, covering over the stump as quickly as possible.

Appendicostomy.—The operation of appendicostomy is required in certain cases of ulcerative colitis and in obstinate cases of constipation. It is performed as follows :

The incision is the same as that for removal of the appendix, but should not be too near the middle line, or
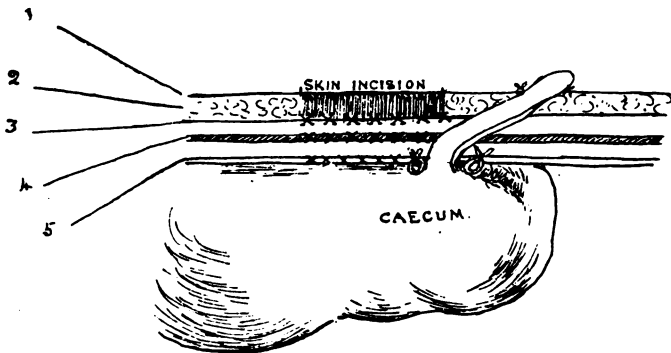
FIG. 113.—APPENDICOSTOMY.

1, Skin; 2, subcutaneous fat; 3, aponeurosis of external oblique; 4, internal oblique and transversalis; 5, peritoneum.

too low down, as it is necessary that the base of the appendix should come into the wound without tension. When the cæcum is exposed, the appendix is searched for in the usual way. Any adhesions are separated, but care must be taken not to divide the meso-appendix, especially the part which contains the main appendicular artery. The appendix should be allowed to lie in an easy position obliquely in the abdominal wall, and, if necessary, a button-hole incision can be made through the abdominal wall, $\frac{1}{2}$ inch below the other incision. The

cæcum close to the base of the appendix is united to the parietal peritoneum by a few interrupted sutures, which go through its serous, muscular, and submucous coats. A continuous suture is not recommended, as there is a danger of strangulating the appendix. The rest of the peritoneal incision is then closed with a continuous suture, and the separated transversalis and internal oblique muscles are united by a few points of interrupted suture. It is better to use catgut rather than silk for these sutures. The tip of the appendix will project about $\frac{1}{2}$ inch beyond the button-hole incision. It is fixed in position by two silkworm-gut sutures, passed between the skin and the serous, muscular, and submucous coats of the appendix. The appendix is not opened for from two to three days, when its tip is cut off, and a catheter is passed down its lumen, through which an aperient injection can be given or lavage performed. When the injection is given, the catheter should be withdrawn. The catheter should not be left permanently in the appendix, as that may lead to gangrene.

CHAPTER VII

INCISIONS INTO THE ABDOMEN, AND THE METHOD OF CLOSING THEM

THE choice of the position of an abdominal incision is of considerable importance. In the first place, except in the case of an exploratory laparotomy, the incision should be made as directly as possible over the organ on which it is desired to operate. In the case of an exploratory laparotomy, the incision should be near the middle line, either above or below the umbilicus, according as it is wished to explore the upper or lower part of the abdomen.

The next point is that the incision should be made in such a place and in such a way that there is no risk of subsequent hernia. The most important factors in preventing hernia are the avoidance of fibrous intermuscular spaces, such as the linea alba or the linea semilunaris, and the separation of the fibres of muscles instead of their division. For this reason the old incision in the middle line either above or below the umbilicus should be abandoned, since it is difficult to secure firm union of the fibrous septa ; this is more especially the case with incisions above the umbilicus, where it is very difficult to unite the cut edges of the linea alba, and hernia is a very frequent result.

In the place of the median incision, the skin should be incised about ¾ inch to one side of the middle line, and to facilitate the accurate closure of the wound after the

operation, Cheyne recommends that the skin should be dissected off the rectus sheath for 1 inch on each side. The anterior sheath of the rectus is then incised along the whole length of the wound, and the fibres of the rectus muscle are then separated with the handle of a scalpel ; of course, if a tendinous intersection occurs in the length of the wound, this will have to be divided with a scalpel. The fibres of the rectus are then held apart with retractors, and the posterior sheath of the rectus is exposed ; this is divided slightly to one side of the incision in the anterior sheath, as shown in Fig. 114, and the peritoneum exposed. This is picked up with dissecting or rat's-tooth forceps, and an opening made in the portion
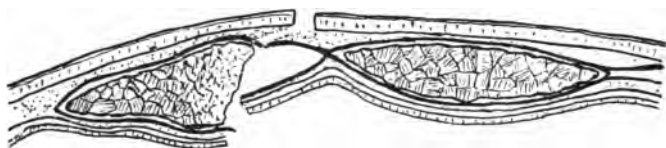
FIG. 114.—INCISION THROUGH RECTUS SHEATH, SHOWING THE DIVISION OF THE SKIN, ANTERIOR AND POSTERIOR SHEATH OF THE RECTUS IN DIFFERENT HORIZONTAL PLANES. (A. BALDWIN.)

picked up. In doing this, it is best to hold the scalpel in a lateral position, so as to avoid any risk of injuring the omentum or intestine. When a small opening has been made in the peritoneum, the edges are caught up with a couple of pairs of forceps, and these are held up in the wound so as to separate the peritoneum from the parts below. The peritoneum is then divided with scissors along the whole length of the wound. If there is difficulty in keeping the omentum out of the way, a finger may be introduced through the wound to prevent the scissors injuring it. The use of a director is not to be encouraged.

In order to prevent the wound from becoming con-

taminated during an intestinal operation, it is advisable to tuck the end of a sterilized cloth inside the incision on each side ; this may be kept in position by a stitch or by special forceps, and will effectually protect the cut edges.

The closure of the abdominal wound is of great importance, and the method of uniting all the structures of each edge with one row of silkworm-gut sutures should never be employed unless the patient is practically moribund. It is very doubtful whether the edges of the peritoneum were ever really brought in contact by this method. It is absolutely essential, in order to have a strong cicatrix, that each layer should be sutured separately. Some surgeons recommend that catgut should be used for the sutures uniting the layers of the abdominal wall in all cases, but in aseptic cases I prefer silk or Pagenstecher's thread, for two reasons—(1) it is more easily sterilized by boiling than other materials ; and (2) it is not readily absorbed, and so acts as a support to the abdominal wall for a considerable time after the wound has healed.

In cases where there is any doubt about the edges of the wound having been soiled with pus, and so infected, it is advisable to use catgut for suturing the various layers of the abdominal wall. In operating on the gall-bladder and the bile ducts, where there is a likelihood of the wound being irritated by the passage of bile over it, catgut sutures should be used.

The peritoneum may be united by means of Halsted's mattress sutures. Two artery forceps are applied to each edge of the peritoneum, and these are firmly held up, so as to separate the peritoneum from the viscera below, as is shown in Fig. 115. Mattress sutures are then inserted ; each suture is commenced ¼ inch from the edge of the peritoneum on one side of the wound, and then it

is passed through the peritoneum of the opposite side of
the wound ¼ inch from its edge, and finally returns through
the two edges ¼ inch from its point of entry.   The stitches
should be ¼ inch apart, and the two threads of each stitch
should be ¼ inch apart.   In a small wound only three or

FIG. 115.—METHOD OF CLOSING THE PERITONEUM.   (A. BALDWIN.)
The edges are held up with artery forceps.   A row of mattress sutures
have been passed.

four are necessary.   When these are tied, they produce
a considerable amount of eversion of the peritoneum, and
insure a smooth line of scar within the abdomen.   The
method of holding up the edges of the peritoneum with
catch forceps facilitates the passing of these sutures very
much.   All the sutures should be passed before any are

tied, and the forceps should only be released and taken off as the sutures are tied.

A slightly quicker way of uniting the peritoneum is to use a continuous suture ; the edges of the peritoneum should be held up, as before described, while the suture is being inserted. It is easy to insert a continuous suture in wounds of the lower half of the abdomen, but in those of the rectus sheath above the umbilicus it is often practically impossible to insert it, and the inter-rupted mattress sutures must be used. When the peri-toneum is shut off, the wound is sponged out with an antiseptic solution, such as biniodide of mercury, 1 in
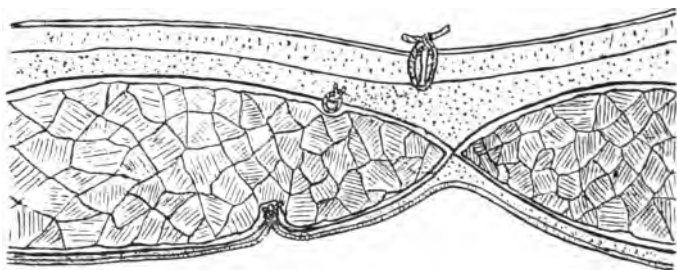
FIG. 116.—THE APPEARANCE OF AN INCISION THROUGH THE RECTUS SHEATH WHEN CLOSED. (A. BALDWIN.)

2,000. The cut edges of the posterior sheath of the rectus are then united with a continuous suture or by a row of interrupted stitches. No suture need be inserted between the separated fibres of the muscle, but its anterior sheath must be united with a row of interrupted sutures, or by a continuous suture. The skin incision should be accurately brought together by a continuous horse-hair suture, or with a few points of silkworm-gut suture.

The best continuous stitch for the skin is a blanket stitch, as shown in Fig. 117. This is greatly preferable to the ordinary continuous stitch, which is exceedingly

difficult to take out. The blanket stitch is very easily
withdrawn by dividing each cross loop ; it leaves a very
good scar. The appearance of the wound when sutured
is shown in Fig. 116. The wound is then dressed as
described in Chapter IX., p. 189.

Such are the general principles for making and closing
incisions into the abdomen. In the case of an operation
for the removal of a portion of intestine or of another
viscus, it is absolutely essential that the wound should be
a free one, and in the case of cancer one must not hesitate
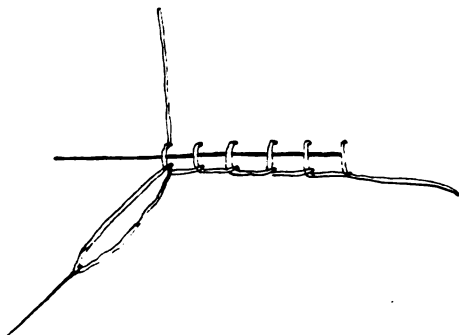
FIG. 117.—BLANKET STITCH FOR THE SKIN. ALSO SHOWS METHOD
OF FINISHING OFF A CONTINUOUS SUTURE.

even to divide the muscles transversely so as to get
enough room, since insufficient room will probably mean
incomplete removal of the disease. I have already re-
ferred to the necessity, in cases of abscess of the appendix,
for making the incision over the dull area. The same
indication will apply to other intra-abdominal abscesses,
such as those in connection with the liver, the gall-
bladder, or the pancreas. In such cases the incision is
made over the centre of the dull area, and muscles may
be divided if space is wanted, since the necessity for
providing free drainage and the danger of disturbing

any intraperitoneal adhesions are of more importance than the risk of hernia.

The position of the incision in cases of removal of the appendix has been described on p. 152.

The incision in cases of pylorectomy or pyloroplasty is best made about the centre of the upper half of the right rectus muscle. This will expose the pylorus well.

In cases of gastro-enterostomy, where there is no question of removal of the pylorus, the incision should be made about ½ inch to the right of the middle line, and the fibres of the right rectus muscle pushed outwards ; this will allow easy access to the jejunum, and, moreover, makes the operation of occlusion of the pylorus easy. In cases of operation on the gall-bladder and bile-ducts, the incision should be made ½ inch to the right of the middle line, and should extend from the level of the umbilicus nearly to the ensiform cartilage ; this is necessary in order to explore the ducts.

The incision in cases of ileo-sigmoidostomy should be made about ½ inch inside the outer edge of the lower half of the left rectus muscle. This will give fairly good access to the sigmoid, which is the more fixed portion of gut. The lower end of the ileum can easily be brought out of this incision.

In none of these incisions is the rectus muscle divided ; only its fibres are separated, and the two layers of its sheath are divided in slightly different planes. When the incision is close to one edge, it is best to push the whole muscle either inwards or outwards.

After the operation the wound must be sutured in layers, as just described.

CHAPTER VIII

THE PREPARATIONS BEFORE ABDOMINAL OPERATIONS

In this chapter is included, not only the preparation of the patient, but also that of the operation room, of the instruments, sponges, etc., and, lastly, of the surgeon himself.

Abdominal operations at hospitals are now always done in the operating theatre, but in a private house some points in the selection of a suitable room are worthy of attention. It should be a large bright room, with a south aspect, capable of being well warmed and ventilated without placing the patient in a draught. A room which is not usually used as a bedroom is preferable to one in ordinary use. The floor should be covered with linoleum, and the walls, if possible, with a washable paper, the ceiling being whitewashed. All curtains, carpets, ornaments, pictures, etc., should be removed from the room some days before ; it is better to remove wardrobes and chests of drawers, so as to avoid the risk of dust being created when these are opened. The floor, walls, paint-work, etc., should be washed over with carbolic lotion, if possible, two days before the operation.

If an operation has to be undertaken in a hurry, and the preparations cannot be made many hours before, it is better to omit moving any furniture, so as to avoid disturbing the dust. Linen sheets should then be placed

over the furniture.   It is a great convenience to choose a room which communicates with another one, since greater quietude is insured not only by the nurse and servants entering by the other room, but also by the washstand and other necessary articles of furniture being removed out of the operation room.   It is almost unnecessary to add that no food should be kept in the operation room.

The temperature of the room is of great importance, since it is very essential to prevent any unnecessary lowering of the patient's body-heat ; this is a most important factor in preventing shock.   Between 75° and 80° F. is the best temperature during the operation.   It is not pleasant for the surgeon and onlookers, but it is best for the patient.

The table on which the operation is to be performed also deserves notice.   It should be 6 feet 6 inches long. not more than 2 feet wide, and from 3 feet to 3 feet 4 inches in height, since a low table is fatiguing to the operator ; a special portable table is of advantage, especially if fitted with a mechanism to enable the Trendelenburg position to be maintained.

Over the table it is best to place a folded blanket for the patient to lie on, as a mattress is quite unsuitable. It is unnecessary to add that the blanket must not have been used on a bed, but must be new, or obtained direct from the cleaners ; it should be covered by mackintosh sheeting and a sterilized sheet.

Two other tables are required at the operation, one for the surgeon's instruments, and one for the sponges and basins of antiseptic lotion or saline solution.   These tables at a hospital should be of enamelled iron, with glass tops, but in private practice, where such tables are not available, ordinary wooden-topped tables can be used ; but these should be prepared by being scrubbed all over, first

with soap and water, and afterwards with 1 in 20 carbolic solution. The tops of each should be covered with a mackintosh, over which is placed a sterilized towel. Some provision is also to be made for the apparatus of the anæsthetist, but this does not call for special description.

Arrangement of the Operation Room.—As before stated, every unnecessary article of furniture should be taken out, and the bed should be put in a part of the room farthest away from where the operation table is placed. The table should stand with its foot 3 or 4 feet from the window, and should never be placed sideways or parallel to the window, since a side-light is useless in abdominal surgery. The surgeon stands on the right side of the patient, and his table is at his right hand, so that a required instrument can be reached with the right hand without stretching over the left. The chief assistant stands opposite to the surgeon, and the table for sponges and lotions is placed just behind and to his left, so that he can easily reach the bowl of sponges. When two assistants are required, the second stands at the operator's left. The anæsthetist stands or sits at the head of the table.

About six good-sized bowls are required for an operation ; they should be of glass, porcelain, or enamelled iron, and must be properly prepared before use. The mere rinsing them with 1 in 20 carbolic solution is quite inefficient, since the solution will not remove caked dirt, blood, or pus ; they should be scrubbed and boiled. On the surgeon's table one or two trays should be prepared for the instruments, and one bowl for the ligatures and sutures, and another for an antiseptic or saline solution for the surgeon's hands. On the assistant's table one bowl should contain antiseptic or saline solution for the assistant's hands, and another should contain the sponges,

and a third the sterilized saline solution for washing the sponges.

A considerable number of towels are required to surround the seat of operation, and when possible these should be sterilized by steam, since mere soaking in 1 in 20 carbolic solution is not sufficient to render them sterile, and, moreover, the use of wet towels is detrimental to the patient. A simple way of sterilizing towels is to boil them in a potato-steamer for twenty minutes. Care must be taken to unfold the towels before sterilizing, otherwise the folded part will not get affected by the steam.

In the preparation of instruments, boiling is now universally employed ; if no special apparatus is at hand, an ordinary saucepan will answer. There are two points to pay attention to in boiling instruments. The first is to let the water boil for some minutes before introducing the instruments, so as to drive off all the air ; and the second, to add some ordinary washing-soda (in the proportion of a teaspoonful to a pint) to the water. These two precautions will prevent the instruments from becoming rusty by boiling. There is some difference of opinion as to whether knives should be boiled, since it undoubtedly affects the cutting edge ; the injurious effect can be reduced to a minimum by wrapping the knife in cotton-wool. Knives can be sterilized efficiently by dipping them in pure carbolic acid, and placing them in methylated spirit. Needles should always be boiled, since it is very difficult otherwise to sterilize their eyes; they should be inserted in a piece of lint before boiling.

After sterilization by heat, the instruments may either be placed in the tray ready for use, or, if prepared at home, for an operation at a patient's house, they should be placed in a sterilized stout linen or holland bag to be

carried to the operation. I have some envelope-shaped bags made, which answer the purpose well; the bags are sterilized before use, and kept in an air-tight box.

Most surgeons prefer to put their instruments before use into some antiseptic solution, a weak carbolic solution being most popular. Personally, I prefer a 1 in 80 carbolic solution; nothing stronger than this should be used, since the peritoneum would be injured by introducing even a small amount of strong carbolic lotion. To absolutely prevent injury to the peritoneum, the instruments may be used dry, or put in sterilized normal saline solution; the latter method is, of course, ideal, but does not prevent the growth of any bacteria which may fall into the tray or have settled on the instruments. If instruments are used dry, blood will become clotted on them, and make them objectionable. When an instrument is fouled with blood or discharge, it must be well rinsed with sterilized cold water. Hot water would coagulate the albumin of the blood, and make it difficult of removal.

Sponges.—The preparation of sponges, or of the materials to be used in their place, is of prime importance. For intra-abdominal work it is necessary to use some material the particles of which will not be left behind in the abdominal cavity; thus ordinary cotton-wool made into swabs should never be employed. Marine sponges properly prepared are excellent, but so also are sponge-cloths or gauze swabs, both of which must be sterilized by heat before use. The thorough preparation of sponges is of so much importance that in serious cases it should be undertaken by the surgeon himself or by someone under his superintendence, and not entrusted to chance. Personally, I would never use sponges for an abdominal operation if I was uncertain about their preparation.

If marine sponges are used, they should be carefully selected. It is best to have one or two large flat sponges to cover exposed viscera, two or three small flat ones to pack round the part, and, finally, six or a dozen round sponges for swabbing. They should be soft, of very fine texture, elastic, and compressible.

There are several methods of preparing them ; I shall refer to two.

In all methods the sponges are freed from sand by frequent washing in water ; in the first method they are placed in water which is changed twice daily for a week. They are then placed in a dilute solution of hydrochloric acid, in which they remain for three or four days ; this dissolves out the remainder of sand and shell. They are then washed in frequent changes of water, and are placed in a strong solution of washing-soda for twenty-four hours ; this solution should contain 1 pound of washing-soda for every twelve sponges. They are then washed in frequent changes of water, and either dried by heat or put in a glass jar containing 1 in 20 carbolic solution.

The second method is recommended by Lockwood. The sponges are soaked for twenty-four hours in a solution of hydrochloric acid in water (1 drachm to the pint), which will remove bits of coral and shell. They are then washed in boiled water which has been allowed to cool to 100° F. in a covered vessel ; from this they are placed in a warm solution of washing-soda (1 drachm to 1 pint of water), and are allowed to remain for half an hour to remove fat and albumin ; they are then washed out in warm sterilized water, and put into a cold solution of sulphurous acid (1 in 5) for twelve hours. This insures sterilization and bleaching. A plate should be placed over the sponges to keep them at the bottom of the receptacle during bleaching, so as to prevent discoloriza-

tion. They are then washed out in sterilized water, and squeezed as dry as possible, after which they are placed in 1 in 20 carbolic solution, and remain there until they are wanted. When required for intra-abdominal use, care should be taken to remove the carbolic acid, which is best effected by wringing the sponges out in sterilized saline solution.

A simple and usual method of cleaning sponges which have not been used for any septic cases is to first thoroughly wash out in plain water, then soak in several changes of soda solution for a couple of days, after which the soda is thoroughly washed out in water, and the sponges squeezed dry and put in 1 in 20 carbolic solution.

Practically by any method a considerable time is taken in preparing sponges, and this fact alone would be sufficient objection to the use of marine sponges in ordinary practice. In hospitals their use is possible, as special sets can be kept for clean abdominal operations. At any rate, their use should be very restricted, and few surgeons would now care to use a marine sponge a second time, the great drawback to their use being the impossibility of sterilizing them by heat, since boiling completely alters the texture of the sponge, and renders it unsuitable for swabbing. For this reason some more easily prepared material is preferable. Absorbent cotton material is now almost universally employed, and the great advantage of its use is that it can be sterilized by heat. Various forms can be used. Soft square sponge-cloths of an open texture, which can be obtained from an ordinary draper, are recommended by some ; these only require boiling for half an hour, and when cool, they are wrung dry and placed in sterilized normal saline solution.

The best form of artificial sponge is one made of several thicknesses of white gauze. Mine are made of eight

thicknesses, and the edges are turned in and sewn, so as to prevent any loose threads being left in the peritoneal cavity. They are made in three sizes, 12 inches square, 6 inches square, and 3 inches square. About twelve of each size are required. They are sterilized by heat, and used dry. A rather quicker method of preparing artificial sponges is by cutting up gamgee tissue into squares of a similar size. The edges of these squares also must be sewn over, so as to prevent any escape of the cotton-wool during use ; they are also prepared for use by sterilization or by boiling. These sponges, however, are not so satisfactory as plain gauze, as they are apt to become lumpy with use. During an operation either sort can be used over and over again after washing them out in saline solution in the same way as marine sponges. Another favourite method of preparing artificial sponges is to wrap up round pledgets of cotton-wool in gauze, which is tied round them ; these are then sterilized by steam or by boiling. Swabs prepared by this method are not so satisfactory as those made from gauze alone, since they are not so absorbent, and cannot be washed after they have been once used.

Ligatures, etc.—Of even more importance than the preparation of sponges and instruments is the insurance of absolute asepsis in ligatures and sutures which are to remain in the wound. Here, again, I should never leave inside the abdomen a ligature or suture prepared at a shop, and I consider it only right to prepare them myself, or have them done under my own superintendence.

The materials employed for ligatures and for sutures in abdominal surgery are silk, Pagenstecher's thread, catgut, silkworm gut, horse-hair, or even fine wire.

The best silk is that known as Chinese twist, and can be obtained in sizes ranging from ooo to 6 ; the three finest

sizes are used for ligatures of small vessels and for intestinal sutures, No. 1 or 2 for sutures of the abdominal wall, and the larger sizes for ligature of pedicles, etc.

The only reliable method of preparing silk is by boiling for some considerable time, and it is also essential to unwind the silk before doing this, otherwise the central part of the hank would not be sterilized.   It is best to wind a small amount on a small glass reel or on a glass microscopic slide, and only sterilize about the quantity which will be needed for each operation ; there must always be some risk in using a reel of silk for a second operation, unless it be sterilized again, and with the finest silks boiling more than. twice will probably make them rotten.

For ligatures the use of Halsted's glass bobbins will be found most convenient.   These little bobbins are held in the palm of the hand, and dispense with the necessity of having ligatures cut off and handed to the surgeon.

My method of preparing silk is to soak it in 1 in 20 carbolic for some hours, and then to boil it in ordinary water for forty minutes.   It is quite unnecessary to boil it in an antiseptic solution ; if carbolic solution be used, the carbolic is quickly driven off by boiling ; and if a mercury salt is used, there is a danger of rotting the silk.   After boiling, the ligatures are placed in 1 in 20 carbolic solution until required for use, when they are placed in a normal saline solution if they are to be used for intra-abdominal work. The addition of some dye, such as carmine, logwood, or methyl blue, to the solution when boiling is an advantage, as not only does it make the fine silk easier to distinguish, but it also in a way affords some indication as to whether the silk has been sufficiently sterilized.   As silk is a non-conductor of heat, the central portion of a tightly-wound spool will probably not be raised to a sufficiently high temperature to insure sterilization ; and also, if the

silk has been too tightly wound, only the outer part of the reel will become dyed. We may therefore assume that if the reel of silk is uniformly dyed right through, its central portion has been raised to a sufficiently high temperature to insure sterilization, but that if only the outer part is dyed and the central portion undyed, there is some doubt as to the asepsis of that silk.

Pagenstecher's thread is prepared in a similar manner. It has the advantage over silk of being stronger, and it never becomes absorbed. Its surface, however, is not quite so smooth as that of silk. When properly sterilized, it never sets up any irritation. Either this thread or silk is invariably used for Lembert's sutures. Silk should never be boiled in soda solution with the instruments, since it is thereby rendered rotten. As ligatures may be weakened in preparation, it is important, before beginning a continuous intestinal suture, to test the strength of the silk. Horse-hair and silkworm gut do not require to be boiled before use ; prolonged soaking in 1 in 20 carbolic is all that is required.

The preparation of catgut is of great importance. The following are the two best methods for its preparation :

By the first method ordinary commercial catgut is scrubbed with soft soap and a brush, and is then thoroughly washed, and wound on glass slides or reels. It is then placed in a watery solution containing 1 per cent. of iodine and 1 per cent. of iodide of potassium. It must remain in this solution for twelve days, at the end of which time it is sterile. It can then be dried, and kept in a sterilized box or, as I prefer, in alcohol until required for use. When required for use, it is put in a bowl of alcohol, and the needles threaded while the catgut is hard and thin. If the catgut be placed in any watery solution before threading the needles, it will be found

much more difficult to manage, as it becomes soft and swollen. This method yields absolutely satisfactory results. It does not interfere with the strength of the catgut, and renders it sterile. The objection to it is the time required for the preparation.

The other method consists in the application of heat, and, since catgut cannot be boiled in water without being ruined, Mayo Robson has advised sterilization in xylol, which is kept at the temperature of boiling water for half an hour. A special metal cylinder with a screw top is required. The catgut is loosely wound on a reel or slide, and sufficient xylol is placed in the cylinder to cover the catgut ; the top is then screwed down, and the cylinder is placed in a saucepan of cold water, which is gradually brought up to the boil, and allowed to remain boiling for half an hour. The catgut is then removed and kept in alcohol. By this method catgut is prepared very quickly, but it is liable to be somewhat weakened, and, moreover, there is some doubt about its sterility.

The Preparation of the Patient may be considered under the two heads of general and local.

It has long been recognized that highly nervous patients are much more difficult not only to anæsthetize, but to treat after an operation. In the same way attempted suicides always give rise to much anxiety after an operation, and, as MacCormac has pointed out, wounded soldiers suffer more severely from shock after a defeat than they do after a victory. We must therefore admit that the nervous system has an influence on the amount of shock after a serious operation ; in this way undue anxiety, or the fear of a fatal termination, creates an unfavourable condition, and should be combated by cheering up the patient, and by dispossessing him of the

12

exaggerated fears of pain, sickness, or of death. In addition, it is best to keep the patient quiet in bed for a few days before the operation, with the nurse who is to look after him, so that he may become accustomed to her beforehand ; and finally, the friends, if anxious and indiscreet, should be kept away as much as possible.

Some authors state that much relief is given in cases of special nervous apprehension by the administration of strophanthus ; 5- to 10-drop doses are given on the last two evenings before, and again on the morning of the operation. It is very important that the patient should have a good night's rest before the operation, and should not be disturbed by any preparations in the early morning. In order to insure sleep, when the patient is very excitable, either ⅓ grain of morphia should be given hypodermically, or 20 grains of sulphonal with 40 grains of bromide of potassium may be administered eighteen hours before the operation.

Attention to the state of the bowels is important ; it is a nearly universal custom to thoroughly clear out the small and large intestine by means of a purge, followed by an enema immediately before the operation. It is, however, doubtful whether it is always wise to do this just before a severe operation, especially if the patient be in a feeble state. My practice is to give a purge, not on the evening before, but, if possible, on the second evening before the operation ; this is followed by an enema on the morning before the operation, which is repeated a few hours before the arrival of the surgeon.

The great objection to the use of enemata is that they produce a drainage of the tissue fluids, which limits absorption, metabolism, and excretion, and predisposes to shock.

Under this heading, too, must be considered the question

of trying to asepticize the intestinal canal by administering antiseptics by the mouth for some days previously. The antiseptics usually employed are salol or beta naphthol ; either can be given in 5-grain doses in a cachet. Small doses of hydrarg. cum cret. can also be used in addition. Though these substances undoubtedly have the power of destroying a certain number of microorganisms in the intestinal tract, yet they apparently disturb the normal assimilation of intestinal products, in which possibly bacteria play some rôle, so it is doubtful whether their exhibition is of any real practical use. When, however, it is decided to employ them, they should be given three or four times a day for several days before the operation.

Of perhaps greater value than these intestinal antiseptics is the use of lactic acid sour milk, and this may be given for a week preceding the operation, but should be stopped forty-eight hours before, since milk leaves a very bulky residue in the large intestine. There is no doubt that the lactic acid bacilli are more efficacious in combating the *Bacilli coli communis* than chemical antiseptics.

With regard to feeding before intestinal operations, a fair amount of food may be given by the mouth up to the day of the operation, taking care, however, for the last twenty-four hours to give chiefly peptones and foods which leave little residue.   It is not advisable to withhold food and give only nutrient enemata.

On the morning of the operation, a cup of tea with sugar, but without milk, is the best thing to take. Failing this, barley-water or albumin-water are good.   Beef-tea is not very desirable, as it may predispose to vomiting.

In an exhausted patient it is desirable to administer, shortly before the operation, a ½-pint saline enema

containing some glucose, and sometimes ½ ounce of brandy.

The next points in the preparation of a patient are those directed towards diminishing the post-operative shock. First among these is the prevention of unnecessary loss of heat. To accomplish this the patient should be warmly clad, and in such a way that no large surface of the body is exposed during the operation ; the ordinary pyjama sleeping-suits of flannel answer the purpose admirably, since the chest, limbs, and the lower part of the abdomen can be kept covered while the upper part is exposed. In female patients flannel drawers, reaching as low as possible, and woollen stockings may take the place of the trousers, but the jacket can be used by both sexes. I may here remark that this clothing should always be of flannel, not of flannelette, since the latter material, besides being highly inflammable, is of no use to keep in warmth. Some surgeons have the extremities bandaged after being wrapped in cotton-wool, but this is not necessary. Greig Smith advised an ingenious device to prevent exposure during the operation. An ordinary blanket is torn in horizontal slips on each side, after the fashion of a many-tailed bandage, and is placed under the patient ; the tails are crossed over the whole of the patient's body and legs, only leaving exposed the area to be operated on. The blanket, of course, is afterwards covered with mackintoshes and sterilized towels.

The next method of preventing shock is by the introduction of artificial serum, which is better known as normal saline solution. The simplest way of making this is by adding common salt to tepid boiled water in the proportion of one and a half teaspoonfuls to a pint. It can be introduced into the system in several ways : First, by intravenous injection, preferably into the median

basilic vein (the mode most usually employed in this country) ; secondly, by subcutaneous injection, the fluid being forced by means of a glass syringe into the loose subcutaneous tissues in the region of the axilla or beneath the breasts ; thirdly, by means of small enemata frequently repeated ; and lastly, by continuous rectal injections. Any of these methods answer, but the last-named is likely to produce some irritability of the rectum and subsequent discomfort. The subcutaneous method is certainly the easiest and quickest to perform, but the intravenous infusion produces the most rapid effect. Whichever method is employed, from 2 to 4 pints will have to be injected.

Stewart Lewis insists on what he calls the saturation method in the management of laparotomy in the place of the older methods, which had the effect of depriving the system of water (by purges, etc.), and so stimulating the absorptive power of the peritoneum. He points out that a certain amount of drainage of tissue fluids is an unavoidable evil in laparotomy, being produced by preliminary purgation, by keeping the stomach empty so as to avoid ether vomiting, and, thirdly, by loss of blood. This loss of tissue fluids should be limited in every possible way. In the preparation of his patients, while emptying and asepticizing the intestinal canal, he insists that the tissues should be fluid saturated to the physiological limit. The diet should be limited to that which will produce the minimum of both gas and toxins. Intestinal antiseptics should be employed, and several mild purgatives should be given instead of one, which is either imperfect or excessive and exhausting. Two or three grains of calomel, combined with some cholagogue, should be given eighteen hours before, and six hours before the operation 4 quarts of normal saline should be injected

into the rectum very slowly, to insure long retention. For forty-eight hours before the operation copious draughts of water are given, 6 to 8 ounces being administered every two hours.

In order to lessen the post-operative shock and the tendency to paralytic dilatation of the intestine, several American surgeons have recently recommended that subcutaneous injections of ergot should be given before and after the operation. Ordinary ergot solution produces a good deal of irritation at the site of the injection, and therefore is not suitable, but an aseptic non-irritating fluid extract called ergone, which is made by Parke, Davis and Co., is of the same strength as the fluid extract, and is very suitable. It is recommended to give 30 minims hypodermically twenty-four hours before the operation, and to repeat the dose every eight hours for three days. The advantages claimed for the use of this drug are : (1) There is less post-operative nausea and vomiting and general shock ; (2) tympanites does not occur, as the ergot causes contraction of the involuntary muscle fibres of the intestine ; (3) it relieves pain almost as efficiently as morphia, or if pain be not relieved a very small dose of morphia will be efficacious, since it produces a nerve calmness ; (4) the bowels are opened with greater ease in cases where ergot has been given, in some cases no aperient being necessary. The method seems worthy of consideration, especially as it is devoid of risk.

It only now remains to speak of hypodermic injections either of morphia alone or combined with atropine, or of the latter drug alone. The use of atropine, I believe, is harmless, but I do not think that a preliminary injection of morphia is absolutely safe, although it certainly enables the patient to be kept unconscious with a smaller

amount of anæsthetic, especially if it is combined with scopolamine hydrobromide ; it is certainly of value where the patient is to be anæsthetized by the open ether method ; the ultimate shock, however, may be greater.

The preparation of the skin demands the utmost attention, especially where portions of the intestine may temporarily rest outside the wound in such operations as posterior gastro-enterostomy and other anastomoses. There are many modifications in the method of preparing the skin, the object of each being to render it as nearly aseptic as possible. The asepsis of the skin will not in most cases be absolute, since bacteria are lodged in the deepest parts of sebaceous glands, and it is practically impossible to be certain of clearing these out. Therefore, after the most elaborate preparation, the skin must still be regarded as a source of danger, and should be kept covered up with sterilized towels, so that no internal organ or ligature touches it. The routine which I employ is as follows : Twenty-four hours before the operation the skin of the whole abdomen is rubbed with ether soap and water by means of a shaving-brush, and if the patient be a hairy man, the whole of the skin of the abdomen is shaved. After this the skin is again scrubbed with the shaving-brush and soap. I never use a nail-brush for the skin. I think its use most brutal in the case of a patient with a delicate skin, and a shaving-brush is equally efficient, as it gets the soap into all the crannies of the skin. The soap is washed off, and turpentine is rubbed in. Next carbolic acid solution, 1 in 20, is applied with a swab, and lastly acetone ; a sterilized towel, soaked in 1 in 40 carbolic solution, is put over the prepared part, and kept in position with a many-tailed bandage. This procedure is repeated on the morning of the operation, and immediately before the operation the skin is again

scrubbed with soap and water, then with some 1 in
1,000 biniodide of mercury, and lastly with acetone.
The shaving-brush should not be used for any other
purpose, but should be kept for this alone ; it should
previously have been sterilized by boiling, when of metal,
or by having been kept in 1 in 20 carbolic acid solution
for twenty-four hours. With regard to soap, either
ordinary yellow, soft-soap, ether soap, or acetone soap
may be used ; personally, I prefer a solution of soap in
acetone, since the acetone enables the soap to penetrate
more deeply into the sebaceous glands. The removal
of fat is effected by ether, benzene, alcohol, turpentine,
or acetone ; the latter is preferable, since it possesses a
slight antiseptic action, and, moreover, is mixable with
water.

Some surgeons are not content with such preparations,
and recommend more extensive ones. Thus Giulot directs
that the abdominal wall should be treated for three
successive days by brushing with boiled water and soap,
followed by alcohol and ether ; after this an antiseptic
dressing is to be applied until the following day. He
also advises that the umbilicus should be thoroughly
swabbed with tincture of iodine. Jessett recommends
that the skin of the abdomen should be scrubbed twice a
day for two days with a 10 per cent. solution of liquor
potassæ, and a pad soaked in 1 in 3,000 sublimate solu-
tion applied after each cleansing.

In cases where there is a discharging sinus, more
especially a fæcal fistula, special precautions are necessary
to prevent the wound becoming infected from the sinus.
Some hours before the operation the sinus should be
swabbed out with peroxide of hydrogen (ten volumes),
and then a plug of gauze soaked in tinct. of iodine packed
tightly into the sinus or fæcal fistula. The skin should

then be brought together over the sinus or fistula by means of a silkworm-gut suture, and a piece of cyanide gauze should be firmly fixed over the sinus and adjoining skin by means of collodion.   The preparation of the skin where the new incision is to be made is then proceeded with in the ordinary way, and in such cases the application of tinct. of iodine is to be preferred.   In cases where there is little time to effectively sterilize the skin, the use of tincture of iodine is very valuable.   It is contended that two applications of tincture of iodine applied at an interval of only a few minutes, are sufficient to completely sterilize the skin.   I employ this method in all acute abdominal cases.   Before the patient is brought into the theatre or operating-room, tincture of iodine is painted over the part of the abdomen where the incision is to be made ; when the patient is under the anæsthetic, the skin is well cleansed with acetone soap and a shaving-brush ; the lather is wiped off, and another application of tincture of iodine is made.

Finally, we must not forget the hygiene of the mouth, since a septic condition of this part may affect a wound of the stomach or intestine, by the swallowing of pus with the saliva.   Not only should carious, useless teeth be removed or stopped, and the teeth carefully cleaned with antiseptic tooth-powder twice a day, but an antiseptic mouth-wash should be employed each time after taking food.   The best washes for this purpose are listerine, glycothymoline, a 5 per cent. solution of peroxide of hydrogen, or a 1 in 80 solution of carbolic acid.

Lastly, we have to consider the preparations to be made by the surgeon himself ; we may consider these, too, under the headings of general and local.   The general preparation includes a healthy mode of life, with some exercise in the fresh air, and avoidance of unnecessary

fatigue, either mental or bodily. Treves specially de-
nounces the practice of carrying a heavy bag just before
an operation, and also advises exercising the muscles of
the arm by dumb-bells, etc.

The clothing of the surgeon is of importance ; his arms
should be bared by rolling up his sleeves, and his outdoor
clothes should be completely covered by an overall, made
of linen, which is sterilized by heat. If this is not at
hand, an ordinary large sterilized bath-towel should be
used.

The main preparation of the surgeon, of course, concerns
his hands and arms, and too much care cannot be directed
to these. The method of disinfection of the hands varies
with different surgeons. The method I adopt is to scrub
the hands and arms with a flesh-brush and ordinary
yellow soap ; after this the hands are cleansed with an
antiseptic ethereal solution of soap. The washing should
take at least five minutes ; after this the hands are soaked
for another three minutes in a 1 in $1,000$ solution of
biniodide of mercury.

With regard to the nails, most of the writers on aseptic
surgery recommend them to be trimmed as short as
possible. I do not, however, think that this is desirable,
since the sensitiveness of the finger-ends is diminished by
having the nails too short. I consider that they should
be about $\frac{1}{16}$ inch long ; when not longer than this, there
is no difficulty in cleansing them with ethereal soap. The
best plan is to clean them with a knife or other special
cleaner, before washing the hands with soap and water,
and then to again remove any loose or sodden epithelium
from under the nails with a cleaner. The disinfection
is completed by scrubbing with ethereal soap and water,
and soaking in biniodide solution.

Various other methods have been proposed for render-

ing the hands sterile, but the difficulties in the way are practically insurmountable, and though the hands may be sterile at the commencement of an operation, it is very rarely that they remain so all through.   Under these circumstances the use of rubber gloves has now become universal, but their use should not allow any relaxation in the preparation of the hands before an operation, since if they become punctured by a needle, and the hands within the gloves are septic, we should be liable to have the wound infected.   On account of the risk of puncture, I fill the gloves with biniodide of mercury solution before putting them on.   At one time cotton and fine silk gloves were used, but these have now been discarded.   The rubber gloves should be of medium thickness, and their surface should be roughened, since this makes it easier to hold smooth instruments.   Such gloves are called " Never-slip."   They should be boiled for ten minutes before use. They should not be boiled in the same sterilizer with the instruments, as the gloves are apt to damage the instruments.   In putting on gloves it is best to fill them completely with antiseptic solution, and then to rub a few drops of ether soap on the hands, and it will be found quite easy to draw on the gloves.   Only the extreme edge of the gloves must ever be touched by the naked hands, and in cases of difficulty in getting the gloves on the fingers, one may be assisted by rubbing with a sterilized nail-brush.   Gloves are now used in every abdominal operation, in aseptic cases for the protection of the patient, and in septic cases for the protection of the surgeon.   At first, intestinal sutures are a little more difficult when wearing gloves, but practice soon overcomes this difficulty.   The other objection to their use is that, if the fingers of the gloves are too short, they will cause cramp in the hands when worn for a long operation ;

in the same way, if the glove is too large. it is very diffi-
cult to feel accurately.   In abdominal operations it is
advisable to wear sterilized linen sleeves to cover the
forearms, over which the gloves overlap.   Many surgeons
wear caps and gauze veils.   The gauze veils are princi-
pally essential for surgeons who wear moustaches or
beards, and in those who perspire freely, in which case it
is also advisable to wind a few layers of white gauze
round the forehead.   The gauze veil is not absolutely
necessary, as it is unlikely that any serious number of
germs will be ejected from the surgeon's mouth, unless
he coughs, sneezes, or talks loudly.

CHAPTER IX

TREATMENT AFTER ABDOMINAL OPERATIONS

THE first point of importance in the treatment after abdominal operations is the dressing. I do not propose to discuss the various forms of antiseptic dressing ; suffice it to say that it is necessary to apply a dressing which is sterile, absorbent, and non-irritating, and there is an advantage in its being impregnated with some chemical which prevents the growth of micro-organisms. I think that Lister's double cyanide gauze answers these requirements. As supplied from the manufacturer, however, it may not be sterile, and so it is advisable to sterilize it by heat, or to soak it in a weak carbolic solution before use ; this latter method has the advantage of removing any free sublimate which may be in the dressing, and which, if allowed to remain, might cause irritation of the skin. In abdominal surgery I always fix the dressing next to the wound by means of acetone collodion ; this avoids the necessity of tightly bandaging the chest and the upper part of the abdomen, and also diminishes the amount of dressings necessary. Unless the dressing is fixed with collodion, the wound may become infected by micro-organisms which have crept under the margins of the dressings. In perfectly clean cases no antiseptics are used in the wound, which is washed over with sterilized normal saline solution before being closed. When, however, any intestinal contents or germs have

come in contact with the wound, it is best to wash out
the wound with biniodide of mercury solution after closing
the peritoneum.   After the edges of the wound have been
accurately adapted with sutures, the surrounding skin is
cleansed with 1 in 1,000 biniodide solution, and a strip of
double cyanide gauze of six or eight thicknesses, and
about 1 inch wide, and the exact length of the wound, is
wrung out in 1 in 40 carbolic and applied to the wound ;
the surrounding skin is then carefully dried with dry
cyanide gauze, and a piece of dry gauze, of one thickness
only, and about 3 inches wider than the moist dressing,
is put over the wound and surrounding skin.   This is
fixed to the skin by brushing on collodion, which is dried
by fanning.   Collodion made with acetone, benzol, and
amyl acetate, is preferable to the ordinary variety ; it
does not irritate the skin, and is less liable to become
loosened.   When the collodion is dry, several thick-
nesses of dry cyanide gauze are placed round it, and
over the wound and the skin some distance over this a
layer of gamgee tissue is applied.   The dressing is kept
in place by a many-tailed bandage, which should be
made, not of one piece of flannel with its sides torn into
horizontal strips, but of six or eight strips of flannel, each
5 or 6 inches wide, and sewn together at the back in such
a way that each strip overlaps the other for one-half its
width.   It should also be made to fit, care being taken
that the tails are neither too long nor too short ; the
simplest way to gauge the necessary length of the tails is
to measure round the most prominent part of the abdomen,
and to make the tails 12 to 18 inches longer than the girth.
It should also be made the right width from above down-
wards ; the first tail should encircle the pelvis, and the
last tail the chest.   The best materials for it are either
ordinary flannel or a very thin variety known as nun's

veiling.   The ordinary flannel is the best in the winter, and the nun's veiling is certainly more comfortable in hot weather.   I always have the backs of my many-tailed bandages lined with silk, as I find that flannel is irritating to patients with sensitive skins.   There is no objection to the many-tailed bandage being loosened and the gamgee tissue readjusted, to make the patient more comfortable, even on the day after the operation, since the fixation of the dressing with collodion prevents any risk of the wound being exposed during the process. The dressing next the wound is left undisturbed for ten days, when it is removed, and the stitches are taken out ; a similar dressing is then reapplied for another week.

In cases where catgut sutures have been used for uniting the various layers of the abdominal wall, it is wise to strap the abdomen after removal of the stitches. Strapping should also always be applied in cases of operation for malignant disease, since in carcinoma the reparative powers of the tissues are always diminished, and there is a risk of the wound breaking down when the support of the stitches is removed.   In such cases strapping should be applied for the first fortnight.   Long strips of rubber strapping are put on over the gauze covering the wound, about ½ inch apart.   A single layer of gauze is then fixed over the strapping with acetone collodion. This dressing can be left in position for a week.

The next point is the management of the patient after the anæsthetic, particularly with a view to diminishing shock, and to preventing, as far as possible, that persistent post-anæsthetic sickness which is a complication fraught with especial discomfort in stomach and intestinal surgery.

In the first place, care should be taken in moving the patient back into bed.   In a hospital there will, of course,

be proper stretchers, which will insure smooth transit from the table to the bed, but in a private house, where there are no such appliances, three people, all on one side, should lift the patient, one placing his arms under the thighs and buttocks, the second his arms under the back and shoulders, and the third supporting the head and looking after the arm on the opposite side, so that it is not bent under the body. The bed should, if possible, be placed at right angles to and close to the table, so as to diminish the distance over which the patient has to be carried. The patient should be carried perfectly horizontally, or with the head at a slightly lower level than the feet ; he should be carefully and slowly lowered on to the bed, and when the moving of the patient is done by porters, the surgeon or nurse should be on the watch to see that the patient is never moved roughly, nor thrown down on the bed.

For use immediately after the operation, the bed should be made up with a low pillow or bolster, and the mattress should be covered first with a clean under-blanket and then with a sheet and draw-sheet. A mackintosh should not be put under the sheet, since it is not necessary in a clean case, and makes the bed rather uncomfortable. Two good-sized pillows are placed under the patient's knees, and the patient is covered with a blanket ; over this a large cradle is placed to keep off the weight of the bed-clothes from the abdomen, and then the ordinary bed-coverings are put on. The whole bed should have been thoroughly warmed by a warming-pan, or, if this is not obtainable, by several hot-water bottles placed inside at the commencement of the operation. Several fresh hot-water bottles also must be in readiness at the end of the operation, so that they can be placed at the patient's feet, and also at the side of his legs and body if

any shock is present.   These bottles must be covered with flannel, and placed outside the blanket covering the patient, and even then care must be taken that no part of the limbs remains in contact with them for any length of time, since burns very readily occur on the legs if hot-water bottles are allowed to touch these parts during recovery from anæsthesia.   I have seen several cases where large portions of the skin of the legs and of the soles of the feet have sloughed, which necessitated many weary weeks of confinement to bed after the patients had completely recovered from the operation.

To prevent shock, the patient should have all wet clothing removed, and a dry, warmed, flannel jacket applied ; this can be done without causing any disturbance, but nothing, which entails moving the patient, should be done till he has regained consciousness.   After a severe operation the feet of the bed should be raised about 6 inches, so as to encourage the flow of blood to the brain.   The patient should be rubbed down with a warm towel to remove the sweat, and also to encourage the circulation.   The room should be warm, either 70° or 75° F., and no draught should be allowed.

The patient must lie on his back, with the head low and turned to one side, so as to facilitate the escape of vomit ; he must not be left alone under any circumstances until quite conscious, since in the nurse's absence he might become choked by vomit, or might suffer from sudden syncope from an attempt to sit up while semi-conscious.

Vomiting.—As has been already stated, anæsthetic vomiting is particularly annoying in stomach and intestinal surgery, since not only is a strain put upon the stitches, but the already half-starved patient is prevented from taking food when, otherwise, it would be allowed.

13

According to Shuter, the duration and severity of the vomiting is influenced by the nature of the anæsthetic ; thus, although vomiting is constant after ether, the most prolonged cases usually follow chloroform. He notes, too, that the worst cases are men in the prime of life, while old people often escape altogether, and children suffer slightly. Anæmic people suffer badly, but alcoholics slightly. One method of preventing vomiting which seems to have a good result is as follows : Immediately after the inhalation of chloroform is discontinued, the patient is made to inhale about 1 drachm of vinegar from a towel. This very frequently has the effect of making the patient sick at the time, but I have certainly found that a considerable number of patients are free from vomiting afterwards ; I therefore think the method worthy of trial. Various drugs have been recommended to prevent or control vomiting, but there are not any which will act with certainty. Spencer gives his patients morphine and atropine every three hours to prevent vomiting, but other surgeons find that these drugs have the contrary effect. Strong black coffee is very refreshing, and acts well in some cases. Ice by the mouth is of very little, if of any value, and has a bad influence in needlessly abstracting heat from the body. When vomiting continues for more than twelve hours some means will have to be employed to check it. One of the best is to give the patient ½ pint of hot water in which is dissolved from 15 to 20 grains of bicarbonate of soda. This often has the effect of making the patient sick, but at the same time enables him to bring up the mucus which is secreted by the irritated stomach. On the other hand, the hot water may not be returned, but may pass onward, and no more vomiting will occur. Strychnine, either by the mouth or hypodermically, is sometimes effective. In

persistent vomiting, also, the bowels must be thoroughly cleared out.

Other drugs which have been recommended, are cerium oxalate, bromidia, and small doses of hydrocyanic acid or of tincture of iodine.   None, however, seem to be of much use.   I have, however, seen good results follow the use of chloretone in 10-grain doses, and I always employ this in obstinate cases.

If vomiting and eructation continue after the second day, and especially if at the same time the temperature be elevated, the mouth dry, and the tongue sticky and coated, it is almost certain that there is some decomposition of the contents of the stomach.   If these contents be allowed to remain in the stomach, they will probably lead to a fatal issue, either by setting up diarrhœa, by keeping up vomiting, or by absorption of toxins.   It is very important that they should be removed at once.   If the stomach is not cleaned out by tumblerfuls of hot water containing a teaspoonful of bicarbonate of soda, repeated three or four times, a stomach-tube must be passed, and the stomach thoroughly washed out with some antiseptic, such as salicylic acid, followed by plain boiled water ; the washing must be continued until the fluid is returned quite clear.   Feeding must be commenced immediately after the lavage, as this will be a favourable time for the absorption of some nourishment. The lavage must be repeated on the next day if vomiting or eructation return.   In some cases it may require to be done daily for five or six days.

Some hesitation might be felt at passing a stomach-tube, and injecting water to wash out a stomach forty-eight hours after an operation on that organ, since this might place a strain on the stitches ; however, it is far better that a suture should undergo a slight strain than

that it should remain soaked in a putrid liquid ; besides, the wound in the stomach is firmly sealed at the end of forty-eight hours, and will practically be as water-tight then as it ever will be. The lavage, of course, must be done gently, the patient lying on his back, and the fluid introduced by means of a funnel, which must not be more than 3 feet above the patient's head ; the fluid must be removed by siphon action, not by expression.

The position of the patient, too, after stomach operations has some influence on vomiting ; thus, after the first few hours the patient should be propped up in bed with one or two pillows, and may also be turned on to the right side, so as to encourage the passage of fluids through the new pylorus.

Shock.—We have already referred, in the chapter on treatment before operation, to the methods which should be employed to prevent shock ; and in this condition prevention is better than cure. If the patient suffer from severe shock during the operation, the amount of the anæsthetic had better be diminished, and the patient kept scarcely under its influence. It may be better, also, after the operation, to leave the patient for a time on the operating-table with the feet raised before removing him to bed ; this, of course, can only be done when the table is heated by hot water, since heat production is lessened during shock, and it is essential to maintain the body temperature by external means. If chloroform has been used as an anæsthetic, 30 minims of ether may be injected with a hypodermic syringe, but the needle must be plunged into a muscle, since, if injected under the skin, not only is the absorption slower, but a considerable amount of skin round the puncture may slough. Food should be given by the mouth or *per rectum* as early as possible.

The most reliable method of treating shock is by

means of normal saline solution. This may be used in four ways: (1) By ordinary enema; (2) by subcutaneous injection; (3) by intravenous injection; (4) by continuous rectal injection or proctoclysis. In slight cases of shock the injection of about 1 pint of warm normal saline solution at a temperature of 110° F. into the rectum is all that will be required; this should be done slowly in order to insure retention, and immediately after the patient has been put back in bed. Half an ounce of brandy may be added to the enema. When the shock continues, the injection may be repeated as often as every hour. In more severe shock the subcutaneous or intravenous injection of normal saline solution is indicated. The subcutaneous method is very popular in France, and it is usual to inject 2 to 4 pints of saline solution subcutaneously during the first twenty-four hours after any severe abdominal operation. In some ways the subcutaneous method is preferable to the intravenous, since it does not cause such a rapid dilution of the blood, a condition which may lead to imperfect aeration and consequent dyspnœa. It has the disadvantage of being rather painful.

For a subcutaneous injection a syringe must be used, and the fluid forced by its means into the subcutaneous tissue, either of the axilla or beneath the breasts. Great care should be taken to sterilize the saline solution; the salt itself must be boiled, and the solution made with boiled water and allowed to cool to the necessary temperature before use. It must be kept in a sterilized bowl, and covered with a sterilized towel. The skin where the puncture is made must also be sterilized, and the syringe and its needle sterilized by boiling.

In the intravenous method, the injection should be made into the median basilic vein; the fluid is introduced

by means of a cannula attached by rubber tubing to a funnel. The funnel should be held about 3 or 4 feet above the arm, and the fluid allowed to run in slowly. The best cannula is a metal one bent at an angle of 120°, tapering towards a blunt point, and with the opening about ¼ inch from the end. This is shown in Fig. 118.

Great care must be taken to keep the temperature of the saline up to 105° and to prevent any loss of heat while going through the rubber tubing; this is best effected by passing the rubber tubing through a bowl of hot water. The other important point is to prevent the introduction of air into the vein. It should therefore be
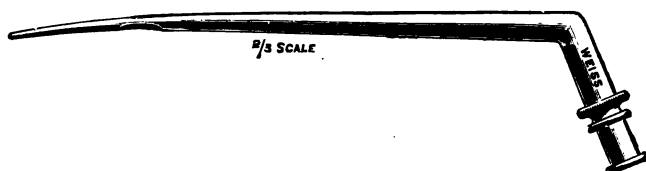
FIG. 118.—CANNULA FOR INTRAVENOUS INJECTION. (WEISS.)

seen that fluid is running freely out of the cannula before the cannula is introduced into the vein. It is also important that the intravenous injection should be continuous; it must never be discontinued and then started again, since there is a danger of a blood-clot forming in the cannula when the injection is discontinued. This blood-clot, when the injection is resumed, may be driven into the right side of the heart and the lungs, producing a pulmonary embolism.

In most cases 2 or 3 pints of saline will have to be introduced, and the quantity may be increased to 5 or 6 pints. The improvement caused by intravenous injection is often very transient, and a second or third injection may be necessary at intervals of a few hours.

The last method of introduction of saline solution is that by continuous proctoclysis. This method is very popular in America, and is used as a routine treatment by many surgeons after all abdominal operations. As soon as the patient has been put back to bed, a large-sized soft rectal tube is passed 3 inches into the rectum, and is

FIG. 119.—APPARATUS FOR CONTINUOUS PROCTOCLYSIS.
(ALLEN AND HANBURY.)

connected with a douche-can by means of 3 feet of rubber tubing. The can contains several pints of normal saline solution which is kept at a temperature of 108° F. The douche-can must be fitted with a thermometer, and with some means of keeping the temperature of the saline constant. The best method, where electricity is available, is by an electric heater, which can be con-

nected with the ordinary house-supply. Such a can is shown in Fig.. 119. The douche-can should not be more than about 6 inches above the level of the bed. The fluid will then run into the rectum at the rate of 1 pint in an hour. If the flow is too rapid, the patient will complain of discomfort, and may return the fluid ; in fact, if the injection is not retained, it generally indicates that the flow is too rapid or the temperature too hot or too cold. The injection is stopped after an hour and a half, and recommenced after an interval of two hours. The rectal tube, of course, is not removed. In this way 10 to 14 pints can be given in the course of twenty-four hours. The method requires considerable skill and care on the part of the nurse. Any·carelessness or failure to see that the rectal tube is properly in position may lead to the bed being flooded and the patient rendered exceedingly uncomfortable. Continuous proctoclysis is supposed to act in four ways : (1) It raises the blood-pressure, and so counteracts shock ; (2) it relieves thirst ; (3) it stimulates lymphatic flow and drains the peritoneal cavity ; (4) it dilutes any toxins present in the blood.

Drugs which raise the blood-pressure are also of great value in the treatment of shock. The most important among these are adrenalin and pituitary extract. Ten minims of adrenalin chloride solution may be added to· ˎ the saline solution used for intravenous or subcutaneous injection, or the drug ,may be injected hypodermically by itself. The effect on the blood-pressure is usually marked, but it is rather transient. Infundibular extract or pituitrin is a much more valuable drug ; after its use the blood-pressure is raised quickly and to a considerable extent, and the effects are more lasting than those obtained after injections of adrenalin. It should be injected in 1 c.c. doses ; each dose represents 0·2 gramme of fresh

posterior lobe of the pituitary body.   The injection may be repeated every two or three hours when necessary.

Hypodermic injections of strychnine used to be the most favourite method of treating shock, but recent physiological experiments tend to prove that so far from diminishing shock, strychnine has the effect of producing it.   Injections of strychnine cause a temporary rise in the blood-pressure, which, however, is followed by a considerable fall, and this fall becomes greater after each subsequent injection.   Its use is therefore undesirable. Digitalin, as a cardiac stimulant, may be of value, but it has little effect on the blood-pressure ; ergot also may be injected, and is sometimes useful on account of its property of raising the blood-pressure by contracting the arterioles, but its action is very transient.   Continuous administration of oxygen is also of great value ; and lastly, since pain by itself may be a cause of shock, morphia injection, by easing the pain, will reduce the shock.

Our most potent means of combating shock are early feeding, warmth, and saline infusion.

Nursing.—Stomach or intestinal cases must never be left entirely alone.   Although special nurses are unnecessary in hospital, in private it is a good rule to have two nurses for the first week, so that the patient may always have one with him.   No special qualification is required for the nurse ; she must be a good surgical nurse, and must be able to pass a catheter on a female without disturbing the patient, and must also be skilled in giving saline and aperient enemata.   She must also never act on her own initiative with regard to feeding, but implicitly follow the directions which are given.   One of her chief duties is to prevent bedsores, and so particular care must be taken that the back of the bandage does not get

wet, either when the patient passes urine or after the administration of enemata. When a bandage is only slightly soiled, a fresh one should be immediately applied. The nurse must take the temperature and pulse-rate every four hours, and must keep a detailed diary of the exact amount of nourishment and of stimulants given by the mouth and by the rectum, and of sleep taken during the day. The pulse is of special importance, and I pay more attention to it than to the temperature, since I regard a rapid pulse as an indication for alcohol. There is seldom retention of urine after stomach or intestinal operations, and so there is no necessity to pass a catheter; but if the patient is unable to pass urine naturally, the catheter must be passed at intervals of not more than ten hours.

Feeding.—The ordinary time to commence feeding after an operation is when the sickness caused by the anæsthetic ceases; therefore as the stomach is always somewhat deranged by the anæsthetic, nothing except teaspoonfuls of hot water are given for the first twelve hours in most severe operations on the stomach or intestines, and then raisin-tea, barley-water, albumin-water, or ordinary tea are allowed in small doses, ½ to 1 ounce being given every hour. Milk, I consider, is unsuitable to commence with, as it forms curds, which are apt to irritate the stomach, and so cause further vomiting. If given at all, it is best in the form of junket, but this should not be given for the first two days. The staple things are barley-water, albumin-water, and raisin-tea. What the patient requires undoubtedly is sugar and water, and the simplest way of giving sugar and water is by means of raisin-tea, which is made by pouring boiling water upon crushed raisins and pouring off the fluid in the same way as is done in making ordinary

tea. This fluid contains grape-sugar, and has the pleasant muscatelle flavour of the raisin. Personally, I do not believe in the nutritive value of beef-tea; it is a stimulant rather than a nutrient; but though of little use, it is harmless, so I do not object to its being taken if the patient likes it.

In uncomplicated cases, after twenty-four hours the amount given by mouth is increased to 2 ounces every two hours, and this is again increased to 3 or 4 ounces after another twelve hours. On the second day the quantity of food can be further increased; Benger's food and black coffee can be allowed. On the third day custard pudding, jelly, lemon sponge, grapes, etc., are given. Immediately the bowels have been opened fish or chicken are ordered, and practically there are no further restrictions in the diet.

During the first few days it may be necessary to supplement this diet by rectal salines. I believe that the most important factor in the treatment of patients after severe abdominal operations is to keep up the normal saturation of body tissues. A man requires about 3 pints of fluid a day. If this amount can be given by the mouth and be retained, the normal saturation of the body tissues will be maintained; but if only a few ounces are given, or can be retained, the balance must be made up in other ways. In my practice this is done by rectal salines, which are given every four hours in $\frac{1}{2}$ pint enemata. In order to add to the nutritive value of these enemata, I now add $\frac{1}{2}$ ounce of grape-sugar to each one. It is important to pass a rectal tube five minutes before giving the enema, and to leave it in the rectum, so as to allow any flatus to escape. If this is done, the patient seldom has any difficulty in retaining the enemata. The number of enemata to be given in the day depend upon the amount

of nourishment taken by the mouth. The number of ounces or pints by which this amount falls below the standard of 3 pints, must be given by the rectum; thus, if only 1 pint is given by the mouth during the twenty-four hours, 2 pints must be given by the rectum. The number of rectal injections is gradually diminished. After the first week cases of operation on the stomach or intestine should be treated in a similar way to any other severe operation, except that after operations for gastric ulcer patients are best kept on a milk diet for some time, but, of course, such diet is not commenced until after the bowels have acted.

Stimulants.—In few cases stimulants will be required till the third or fourth day, when solids are given by the mouth ; then a little champagne with the principal meal is indicated. In a case where there is considerable shock, however, stimulants must be pushed earlier, and in deciding upon this point, and also on the quantity to be given, I am guided by the pulse. A rapid pulse demands stimulants, and if necessary they may be pushed to a very large amount ; thus I have kept a patient alive for a month after a serious operation by giving each day 16 ounces of brandy and 18 ounces of champagne.

Champagne is apt to produce vomiting if given early, and also gives rise to flatulence. Brandy, therefore, is to be preferred, and for a similar reason should not be mixed with soda-water ; other stimulants given are rum, red wine, and beer. The last-named is very useful when the patient expresses a wish for it, since the malt which it contains is of some nutrient value ; it also acts as an aperient.

Management of the Bowels.—In abdominal operations, not only is it advisable to clear out the intestine thoroughly before the operation, but the bowels must never be allowed

to become constipated after the operation.   In many abdominal cases there will be some temporary paralysis of peristaltic action, caused by exposure of, or by the application of irritating substances to the intestine, and we must use every endeavour to re-establish the normal peristalsis as soon as possible.

One reason for the early opening of the bowels is the avoidance of the condition known as pseudo-ileus, which is a form of intestinal obstruction brought about by paralysis of the gut from exposure or injury, and is often combined with the formation of adhesions in such a position as to cause a kink.   The condition is fairly common in operations on the lower part of the abdomen. It has often been confused with peritonitis, and has led to the idea that peritonitis is cured by purgatives ; there are, however, no signs of peritonitis post-mortem in fatal cases.   Pseudo-ileus differs also from other intestinal obstruction by its rapidly fatal course if unrelieved, death being probably due to the absorption of toxins of the *Bacillus coli communis* from the paralyzed gut.   In order to guard against this condition, which arises from paralysis of the gut, our aim must be to re-establish the normal peristaltic action as quickly as possible.   The first means by which we attempt to do this is by the passage of a flatus tube about 4 or 5 inches up the rectum every four hours, and leaving it in position for five minutes ; this enables the gas to be expelled by the enfeebled peristaltic contraction, which would otherwise not have sufficient force to conquer the resistance of the anal sphincter, and the retention of flatus would prevent the bowel from returning to its normal condition of tonic contraction.   Early feeding, too, will help our object, and hot fluids by the mouth are more conducive to the production of peristaltic action than milk diet,

starvation, or ice. The most important point, however, is to obtain an early action of the bowels. An enema of soap and water, or of turpentine and gruel, should be given on the second or third day after the operation, and is usually efficacious. Some surgeons recommend a purge in addition—thus Spencer gives calomel on the second day—but I am inclined to rely first on the action of enemata, and to give a purge by the mouth only if enemata are unsuccessful. When the enema has·not produced a satisfactory result, I give 2 to 5 grains of calomel in grain doses at intervals of one hour, followed by 1 ounce of mist. sennæ co., or a pill containing calomel and colocynth, to be followed in the morning by 1 ounce of mist. alba, to which had been added 5 minims of tincture of belladonna and 10 minims of tincture of nux vomica, this can be repeated every four hours. In cases where aperient medicine cannot be given by the mouth, in consequence of vomiting, and no result has followed a simple enema, we must next try one of the purgative enemata, the most useful of which are the following:

1. Ol. ricini, turpentine, of each 1 ounce in 10 ounces of thin gruel.

2. The British Pharmacopœia enema terebinthinæ, containing 1 ounce of turpentine to 15 ounces of mucilage of starch. This preparation, however, is rather strong, and I usually employ an enema of 1 pint of gruel containing 1 to 2 drachms of turpentine.

3. Enema sulphate of magnesia (or enema catharticum, B.P.) : ℞ of sulphate of magnesia 1 ounce, olive oil 1 ounce, mucilage of starch 15 ounces.

4. Enema of aloes (B.P.) : Aloes 40 grains, carbonate of potash 15 grains, mucilage of starch 10 ounces.

5. Enema of colocynth contains ext. colocynth ½ drachm, soft soap 1 drachm, water 1 pint.

6. Enema of ox bile.

7. Enema of glycerine 1 to 2 drachms injected undiluted, or in the form of a suppository. This latter, however, is not of much use immediately after an operation, except in children, and may cause tenesmus.

Where aperient enemata have failed, and where aperients cannot be given on account of vomiting, subcutaneous aperient injections should be tried.

The best method of carrying out this treatment is to dissolve 15 grains of anhydrous sodium citrate in 4 ounces of distilled water, and to inject it subcutaneously in two parts, with an interval of an hour between the injections. This may have to be repeated two or three times. It has proved beneficial in some cases.

In cases where there is much flatulent distension of the abdomen, hypodermic injections of pituitary extract will often prove of benefit by causing contraction of the muscular coats of the intestine. In some cases flatus will be passed, and the bowels will act immediately after the injection without the aid of any aperient, but in other cases it is advisable to give enemata at the same time. The injections of pituitary extract may be repeated at intervals of two hours.

A good number of patients after operations on the stomach do not require any aperient, as the bowels act naturally on the second or third day; in a few cases, also, troublesome diarrhœa follows the operation. In such cases the amount of liquids given should be diminished, the stomach washed out, and tincture of opium must be given by the mouth. This will usually suffice to stop the diarrhœa, but in some cases the diarrhœa has caused a fatal issue without leaving any signs at the post-mortem.

Rectal Feeding. — Rectal alimentation, as usually

described, will practically never be required after ab-
dominal operations. It is doubtful if any of the various
so-called nutrient enemata have any nutrient properties
at all, since in most cases the only substances which can
be absorbed by the rectum are water, salts, sugar, and
stimulants. Moreover, nitrogenous products have a great
tendency to decompose in the rectum, and to cause
irritability of the bowel after quite a short time.

We may say that nutrient enemata have been com-
pletely displaced by simple salines, and when glucose
has been added to each enema, it will contain probably
as much absorbable nourishment as the old messy prepara-
tions formerly given. If for any reason nutrient enemata
are given, instead of salines, the bowel must be thoroughly
washed out with saline solution each day to remove
the débris. Nutrient or saline injections should be given
to the patient when lying on his back, and he should not
change his position for some time after the injection.
The rectal tube must always be inserted, and left in for
five minutes before the enema is given, and this should
be given by gravity alone. In cases where rectal ene-
mata have to be continued for any length of time, and
the rectum becomes irritable, 2 or 3 minims of tinct.
opii should be added to each enema. Some surgeons
also add some disinfectant to each enema, either beta-
naphthol or salol ; from 2 to 5 grains of either can
be given, but this is unnecessary when no animal matter
is given in the enema. Alcohol also acts as a disinfectant
as well as a stimulant, and when its use is otherwise
indicated, brandy may be added to each injection.

Mouth and Teeth.—As in the preparation before an
operation special attention was drawn to the necessity
of rendering the buccal cavity as aseptic as possible, so
also after an operation this point is still of importance.

The teeth should be gently brushed with some antiseptic tooth-powder at least twice a day, commencing on the day after the operation, and the mouth rinsed out with listerine glycothymoline, or peroxide of hydrogen. All accumulation of food and sordes should be removed from the gums and teeth by means of a small piece of wool soaked in dilute carbolic or peroxide lotion. Attention to the state of the mouth is of great importance ; not only does it prevent decomposition of the stomach contents, with its consequences of vomiting and diarrhœa, but it prevents septic broncho-pneumonia, which has been a fruitful cause of death after stomach operations, and, finally, it prevents the formation of a parotid bubo, which may lead to suppuration and exhaust the patient's strength.

Position of Patient. — As before stated, it is undesirable that the patient should lie flat in bed after stomach and intestinal operations. When the patient is suffering from severe shock, it is, of course, necessary to keep him lying flat, with the head low, but as soon as the shock passes off he should be placed in a half-sitting position—" Fowler's position " ; this is best maintained by the use of the pillow bed-sling shown in Fig. 120. In order to prevent the patient slipping off the pillow bed-sling, a firm, wedge-shaped bolster is placed under the patient's knees. The bolster should have pieces of webbing sewn to each end, by which it is attached to the head of the bed, and so is prevented from slipping down. The combination of the pillow bed-sling and the firm bolster keeps the patient most effectively in the Fowler position, and is most comfortable. The advantages of the Fowler position are many : First, in cases of gastro-enterostomy it favours the escape of gastric contents through the new opening ; secondly, in cases of rupture of

14

a gastric or duodenal ulcer it insures that extravasation will not find its way into the subphrenic spaces, where it would produce the dangerous complication of sub-phrenic abscess, but that any free fluid will track into the pelvis, where it will form a comparatively harmless pelvic abscess; thirdly, it counteracts any tendency to hypo-static congestion of the lungs ; fourthly, it tends to prevent the formation of pseudo-ileus ; and if flatulent distension is present, it prevents any danger of interference with the heart's action.

FIG. 120.—POSITION OF PATIENT AFTER ABDOMINAL OPERATION : PILLOW BED-SLING IN USE.

After the first day, if the patient is tired of the Fowler position, there is no objection to his being let down to the flat position for a time ; after three or four days he may also be turned on his side for a little time. Needless to say, he must not move himself, but must allow the nurses to make any change in his position.

In a simple, uncomplicated case of abdominal section the patient should be kept in bed for fourteen days, and may then be moved on to a couch ; but he should not be allowed to walk for another two or three days. In

hospital practice the patient usually leaves the hospital at the end of three weeks.

I have not made any mention of peritonitis, since in clean cases it will only occur after faulty suturing, or where septic material has been introduced, either by the surgeon's hands, instruments, ligatures, or sponges. In cases of operation for septic tubal abscesses, or for those connected with the vermiform appendix, peritonitis is a real danger, and may occur after imperfect cleansing of the cavity ; it is best avoided by thorough drainage and by continuous rectal proctoclysis.

There are two other points which require notice : the first is the administration of morphia, and the second is the admission of visitors.

Many surgeons have a great prejudice against the use of morphia hypodermically during the first days after an operation, because it may produce vomiting, and also may delay the re-establishment of peristaltic action, and consequently may tend to pseudo-ileus and to the formation of adhesions. Other surgeons, especially Spencer, to whom I have referred before, make a rule of giving morphia and atropine regularly, so as to prevent vomiting. I believe that a middle course should be followed, and I usually give one hypodermic injection of from $\frac{1}{6}$ to $\frac{1}{4}$ grain of morphia combined with atropine on the night following the operation, since I think that a bad night does far more harm than the morphia. Morphia certainly has a paralyzing action on the intestine, so I do not give another injection until I have evidence of the re-establishment of peristaltic action in the intestines, as shown by the passage of flatus *per rectum*. In some cases morphia undoubtedly increases the tendency to and duration of vomiting, but this does not usually continue when the drug is discontinued, and if not

excessive, even vomiting is preferable to severe pain and want of sleep.   In some cases morphia even seems to help in the re-establishment of peristaltic contraction, and I have frequently had cases where flatus was passed freely after a small injection.

With regard to visitors, after any serious abdominal operation no one should be allowed to see the patient during the first twenty-four hours under any circumstances, except where the case is apparently hopeless. With an unexcitable patient the nearest relative, if a sensible person, may just see him for two or three minutes on the second day, and have a short talk on the following day ; not more than one person at a time, however, should be admitted during the first week.   The patient, too, must be encouraged to refuse to see visitors if he does not really wish to ; many patients are afraid of hurting their relations' feelings by refusing to see them.   At the end of a week visitors are a welcome change, and their presence can do nothing but good. During the first few days the patient should not be left alone with a visitor, but the nurse should remain on guard.

INDEX

THE END

54306

M540   Bidwell, L.A.
B58   A handbook of
1911   intestinal surgery.

NAME

John Rosano

DATE DUE

APR 14 1932